

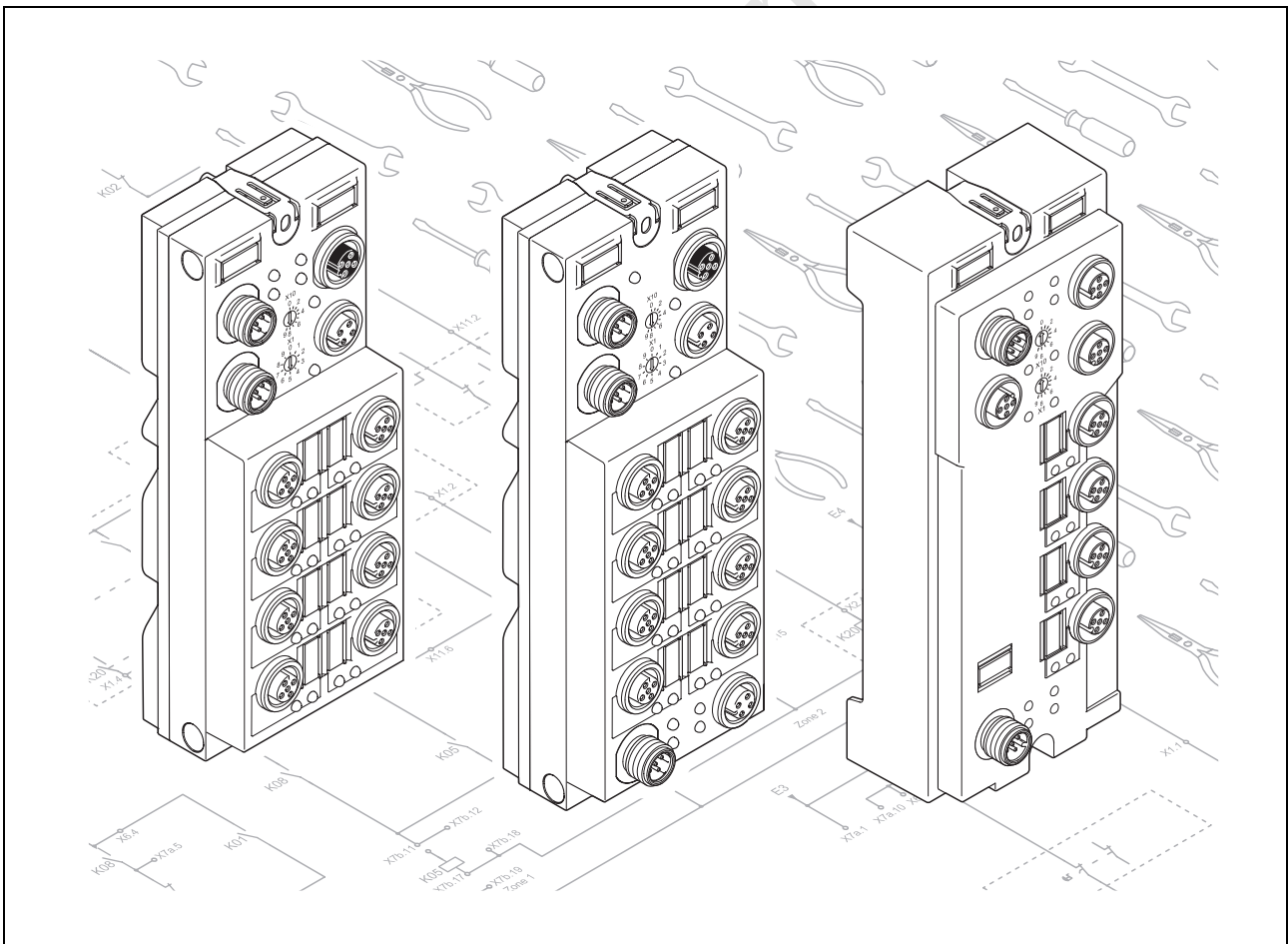
AUTOMATIONWORX

User Manual

FLS FLM PB SYS PRO UM E

Order No.: 26 99 07 9

Configuring a PROFIBUS-DP System Using Devices
in the Fieldline Product Range



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AUTOMATIONWORX

User Manual

Configuring a PROFIBUS-DP System Using Devices in the Fieldline Product Range

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Designation: FLS FLM PB SYS PRO UM E

Revision: 02

Order No.: 26 99 07 9

This manual is valid for:

Devices of the Fieldline Product Range for the PROFIBUS-DP Bus System

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Please Observe the Following Notes:

In order to ensure the safe use of your device, we recommend that you read this manual carefully. The following notes provide information on how to use this manual.

User Group of This Manual

The use of products described in this manual is oriented exclusively to Phoenix Contact. Phoenix Contact accepts no liability for erroneous handling or damage to products from Phoenix Contact or third-party products resulting from disregard of information contained in this manual.

Explanation of Symbols Used



The *attention* symbol refers to an operating procedure which, if not carefully followed, could result in damage to hardware and software or personal injury.



The *note* symbol informs you of conditions that must strictly be observed to achieve error-free operation. It also gives you tips and advice on the efficient use of hardware and on software optimization to save you extra work.



The *text* symbol refers to detailed sources of information (manuals, data sheets, literature, etc.) on the subject matter, product, etc. This text also provides helpful information for the orientation in the manual.



For use in potentially explosive areas, please observe the following:

- THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D OR IN NON-HAZARDOUS LOCATIONS ONLY.
- WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I; DIVISION 2.
- WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS:
- ALL WIRING OF THESE DEVICES MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ARTICLE 501.4(B) FOR CLASS I, DIVISION 2.

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1 Fieldline at the PROFIBUS-DP

1.1 The Fieldline Product Range

The input and output devices in the Fieldline product range are designed for distributed automation tasks in harsh environmental conditions. The devices meet the requirements for IP65/IP67 protection. They enable the direct connection of sensors and actuators in an environment close to the station.

The Fieldline product range includes the Fieldline Stand-Alone (FLS) and Fieldline Modular (FLM) product groups.

Fieldline Stand-Alone devices cannot be extended and have a directly integrated fieldbus connection and I/O level. They are used for distribution in the field when only a few digital I/O points are required.

Fieldline Modular devices consist of a bus coupler (gateway) and I/O devices that can be connected. They are used for special functions, primarily for applications with a high I/O node density and complex functions.

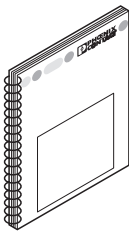
1.2 Documentation for Fieldline Devices

The documentation for Fieldline devices is modular, providing you with the optimum information for your specific bus system.



This user manual describes only the PROFIBUS-specific features of the devices.

You also require the following documentation:

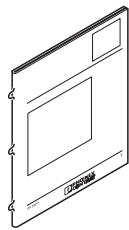


Installation of Devices in the Fieldline Product Range FLS FLM SYS INST UM E (Order No. 26 98 97 3)

This user manual describes the devices for all bus systems.

This includes:

- The device properties, which are the same for all bus systems
- Mounting
- The voltage supply concept and connection



Device-Specific Data Sheet

The data sheet describes the specific properties of a device.

This includes:

- Function
- Local diagnostic and status indicators
- Connector pin assignment and connection example
- Configuration data
- Technical data

1.3 PROFIBUS-DP

PROFIBUS was developed as an open fieldbus in 1983 and was standardized in DIN 19245 in 1991. In 1996, PROFIBUS was defined as the European standard in EN 50170.

1.3.1 Structure of PROFIBUS-DP

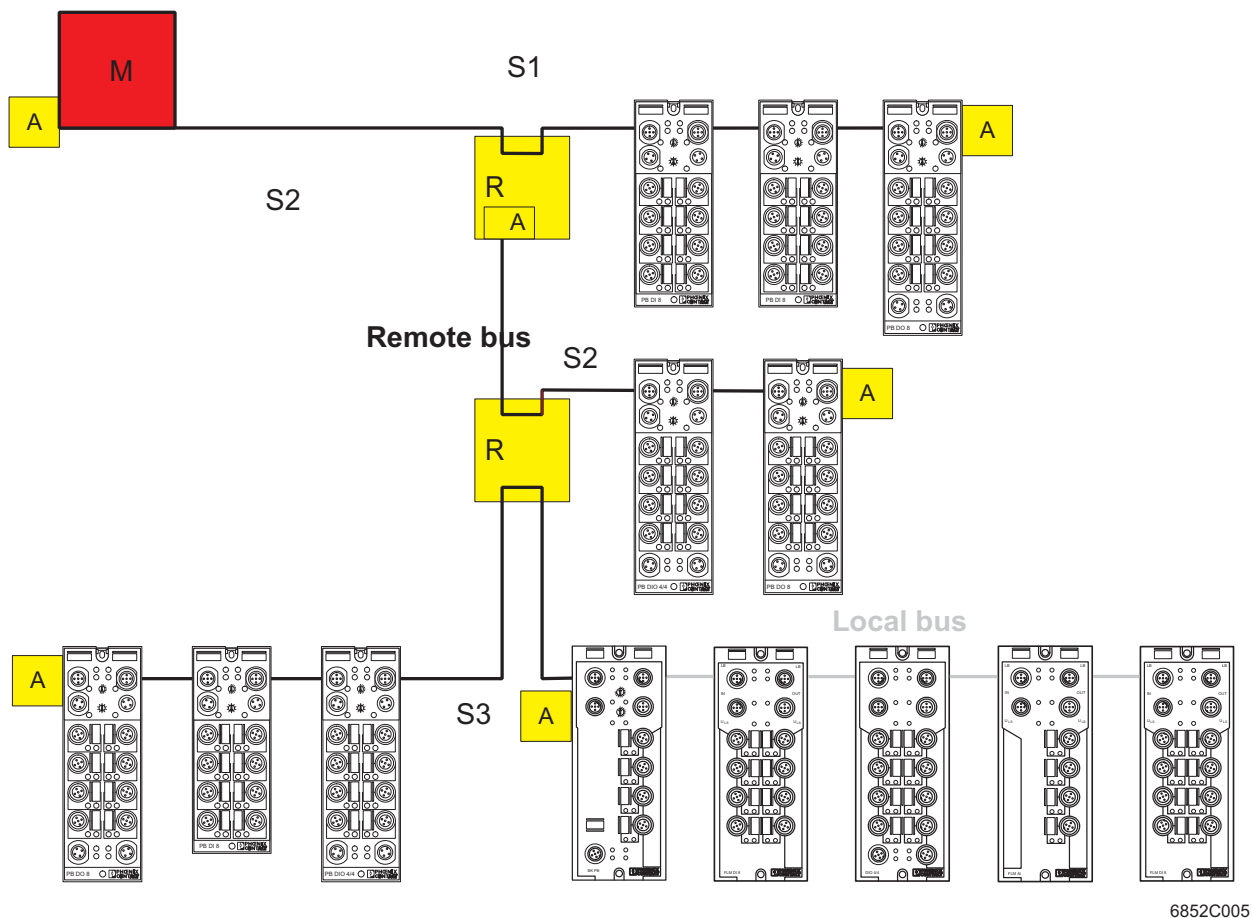


Figure 1-1 Typical structure of an PROFIBUS-DP system with remote bus and local bus

Key for Figure 1-1:

M	Master
A	Termination resistor
R	Repeater
R/T	Repeater with termination resistor
Sx	Segment

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Table 1-1 Basic network specifications

Topology	Linear, active bus connection at both ends of a segment (termination resistor); branch lines are permitted
Number of stations in a segment	32 (without repeater) 127 (with repeater)
Number of repeaters between two devices	9, maximum
Maximum expansion of the bus	Depending on the transmission speed (see Table 1-2 on page 1-5); up to 1.2 km at 93.75 Kbps, maximum; the expansion can be increased with the help of repeaters
Transmission speed	9.6 Kbps to 12 Mbps, can be adjusted in increments (see Table 1-2 on page 1-5).



Repeaters can be found in the latest Phoenix Contact INTERFACE catalog.

1.3.2 Address

In the PROFIBUS-DP network, each device is identified by its address (device ID, station address). For Fieldline Stand-Alone devices, all addresses between 1 and 99 are allowed, whereas the addresses for Fieldline Modular devices are between 1 and 126. In a PROFIBUS-DP network, an address can only be assigned once.

The device address is set using the rotary encoding switches (see section "Setting the Address" on page 2-7).

1.3.3 Baud Rate

Fieldline devices for PROFIBUS-DP have an automatic baud rate detection function, which therefore must not be set. After power up, the Fieldline device detects the baud rate and stores it as long as the supply voltage is present.



If you modify the baud rate of the master, you must disconnect and reconnect the supply voltage for the Fieldline Stand-Alone device so that it detects the modified baud rate.

The bus cables for the PROFIBUS-DP system are specified in standard EN 50170. According to this standard, the maximum length of a bus segment depends on the baud rate.

Table 1-2 Baud rate and line lengths

Baud Rate in kbps	9.6	19.2	93.75	187.5	500	1500	12000
Line length in m	1200	1200	1200	1000	400	200	100
Length of branch lines in m	< 6.6						None



Only **one** baud rate can be used at a time in a PROFIBUS system.

1.3.4 Laying the PROFIBUS Cable

When laying a PROFIBUS cable, please observe the following:

- Do not lay signal and bus cables parallel to power cables or in bundles with power cables.
- Lay PROFIBUS cables and cables with direct voltages > 60 V and alternating voltages > 25 V in separate bundles or cable ducts.
- Always lay signal cables and equipotential bonding together in one channel, following the shortest route.
- Avoid extending the PROFIBUS cables with connectors.
- Do not lay PROFIBUS cables in bundles with telephone lines and cables leading to potentially explosive areas.
- As a rule, avoid branch lines.

1.3.5 Mains Termination Resistors

In PROFIBUS-DP, the individual branches must each be terminated with a termination resistor.

The Fieldline devices do not have a resistor of this type.

For recommended termination resistors, please refer to the device-specific data sheet.

It is either screwed on to the BUS OUT connection or, if T-pieces are used (for Fieldline Stand-Alone devices), screwed onto the open connection of the T-piece.

1.3.6 Assembly Guidelines for PROFIBUS Networks

Important information on system planning, installation instructions when using PROFIBUS, and starting up PROFIBUS systems can be found in the assembly guidelines for PROFIBUS.

This information is published by the PROFIBUS user organization (see also www.profibus.com).



If you are designing your system with Fieldline and PROFIBUS, you must observe the information provided in the documentation in section 1.2 as well as the assembly guidelines for PROFIBUS.

1.3.7 Fieldline Modular Local Bus

A Fieldline Modular local bus is a bus connection that branches off from a remote bus via a bus coupler (FLM BK PB) and connects the Fieldline Modular local bus devices with each other. The bus coupler opens a powerful local bus, which can be used to connect up to 16 more devices. Devices are Fieldline modular local bus devices used to implement a local bus station. The bus coupler provides the power supply.

The maximum total length of a local bus is 20 m. The transmission speed can be switched from 500 kBaud to 2 MBaud.

The bus coupler can be connected with up to 8 digital sensors via M12 connectors. The slots are double-occupied. The bus coupler supplies the supply voltage for the sensors and reads in the provided signals.

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2 Connecting Bus Cables and Setting the Address

2.1 Connection Options for the Bus



In the following, a cable that conforms to the fieldbus specification must be used to connect PROFIBUS-DP.

Use shielded M12 connectors to connect the bus. The thread of the M12 connector is used to connect the shielding to functional earth ground and in some cases a pin is also used.



Phoenix Contact recommends the use of pre-assembled bus cables (see Phoenix Contact AUTOMATIONWORX catalog).

If you assemble the cables yourself, please follow the description provided in the Fieldline FLS FLM SYS INST UM E user manual (Order No. 26 98 97 3) and the device-specific data sheet.

For PROFIBUS-DP there are two ways of connecting the bus:

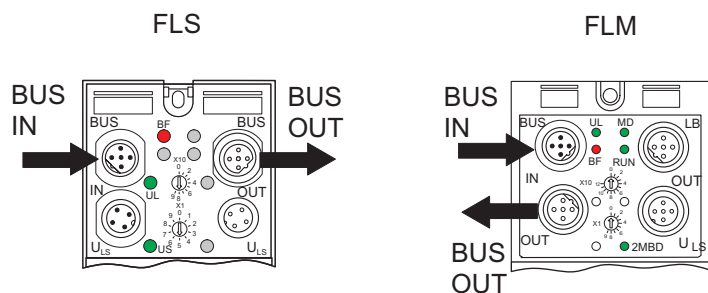
1. Connect the incoming PROFIBUS to the BUS IN socket and the outgoing PROFIBUS to the BUS OUT socket.
2. When using Fieldline Stand-Alone you can also connect the PROFIBUS via a T-piece.

When using Fieldline Stand-Alone, the PROFIBUS-DP can be connected via the BUS IN and BUS OUT connections or via T-pieces up to a maximum transmission speed of 1.5 Mbaud. If higher transmission speeds are used, the bus must be connected via T-pieces with integrated series inductance.

For transmission rates of more than 3 Mbaud, series inductance is available in the Fieldline Modular devices. For this reason we recommend to connect Fieldline Modular devices via BUS IN and BUS OUT. Please observe the installation instructions of the PROFIBUS User Organization.

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BUS IN / BUS OUT



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Figure 2-1 Bus connection via BUS IN / BUS OUT

Accessories: Two M12 connectors

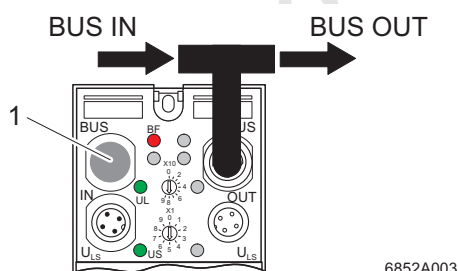
Advantage: No additional accessories required.

Disadvantage: – When the bus is running, no devices can be removed or added without physical interruption.
– Supports transmission rates of up to 1.5 Mbaud (FLS).

T-piece (FLS)

For Fieldline Stand-Alone devices, a T-piece is used to connect the bus, this must be connected at the **BUS OUT** connection.

To ensure IP65/IP67 protection, cover the unused connection with a protective cap (1).



6852A003

Figure 2-2 Bus connection via T-piece

Accessories: Two M12 connectors, 1 T-piece, 1 protective cap

Advantage: – When the bus is running, devices can be removed or added without physical interruption. To do this, the master and the control program must support the removal and addition of devices.
– Supports all transmission rates.

Disadvantage: Additional accessories required.

2.2 Connecting the Bus and Termination Resistor

FLS

For a Fieldline Stand-Alone device that is followed by another device, the incoming and outgoing bus must be connected (Figure 2-3, A1 and B1). For the last device of a PROFIBUS segment, only the incoming bus is connected (Figure 2-3, A2 and B2). A termination resistor (1) is placed in the connection for the outgoing bus. To ensure IP65/IP67 protection, cover the unused BUS IN connection with a protective cap (2).

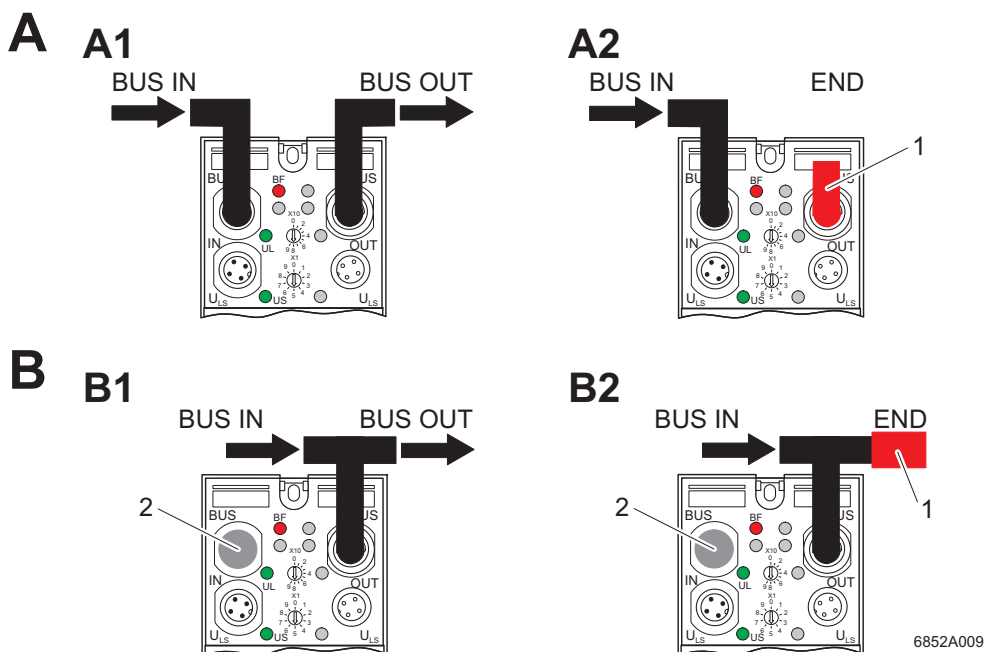


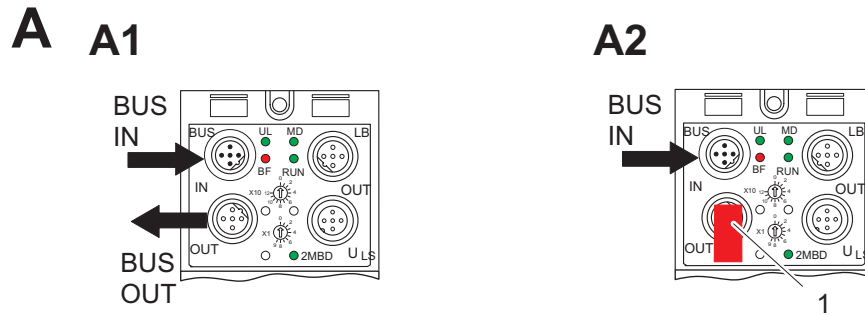
Figure 2-3 Options for connecting the bus and termination resistor of Fieldline Stand-Alone devices

- A** Connection via BUS IN / BUS OUT
 - A1** Incoming and outgoing bus
 - A2** Incoming bus and termination resistor
- B** Connection via T-piece
 - B1** Incoming and outgoing bus
 - B2** Incoming bus and termination resistor
- 1** Termination resistor
- 2** Protective cap for the unused connection

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FLM

For a Fieldline Modular device, the incoming and the outgoing bus must be connected (Figure 2-4, A1). For the last device of a PROFIBUS segment, only the incoming bus is connected (Figure 2-4, A2). A termination resistor (1) is placed in the connection for the outgoing bus.



6852B009

Figure 2-4 Options for connecting the bus and termination resistor of Fieldline Modular devices

- A** Connection via BUS IN / BUS OUT
 - A1** Incoming and outgoing bus
 - A2** Incoming bus and termination resistor
- 1** Termination resistor

Connecting Bus Cables and Setting the Address

2.3 Connecting the Bus

Connect the PROFIBUS via BUS IN / BUS OUT or via a T-piece (for FLS only) (see section "Connection Options for the Bus" on page 2-1).

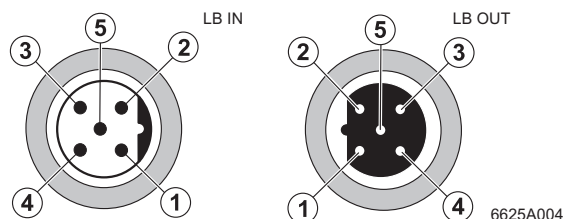


Figure 2-5 PROFIBUS-DP pin assignment (connections on the device)

Pin	IN	OUT	Note
1	VP	VP	Supply voltage for active bus connection (termination resistor)
2	RxD/TxD-N (A)	RxD/TxD-N (A)	
3	DGND	DGND	
4	RxD/TxD-P (B)	RxD/TxD-P (B)	Reference potential of the RS-485 transceiver of the station
5	Shield	Shield	Placed directly on FE

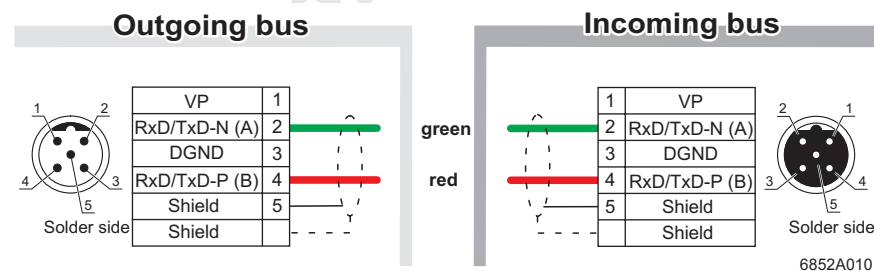


Figure 2-6 Connector pin assignment of the M12 connector (connector on the cable)



The thread and pin 5 are used for shielding.

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Pin assignment of the local bus for Fieldline Modular devices

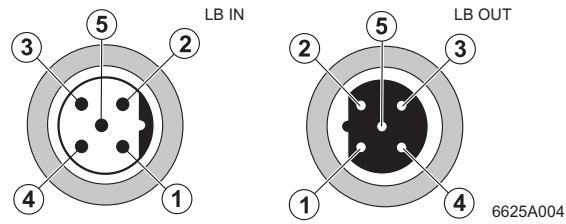


Figure 2-7 Pin assignment of the local bus (FLM)

Pin	LB IN	LB OUT
1	DO	DO
2	$\overline{DO}$	$\overline{DO}$
3	DI	DI
4	$\overline{DI}$	$\overline{DI}$
5	GND	GND

PROFIBUS-DP cables available on the market usually have one wire pair (red and green), which is protected by a braided shield and membrane.

The data lines are labeled A and B. If a cable with red and green wires is used, you should select the following assignment for both the incoming and outgoing bus:

Data line A	Green
Data line B	Red

Encoding of the connections

In the PROFIBUS-DP system, the connections for the bus are B-encoded and the connections for the supply voltage are A-encoded. In this way, the bus and supply voltage cannot be mixed up.

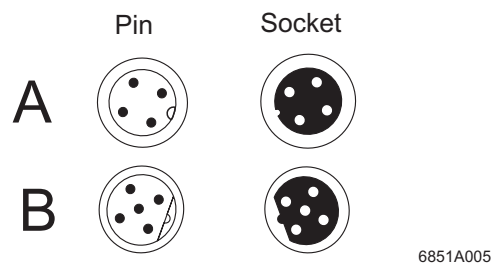


Figure 2-8 Difference between A and B-encoding (connections on the device)

Connecting Bus Cables and Setting the Address

2.4 Setting the Address

The address of a device (device ID, station address) is set using two rotary encoding switches. Rotary encoding switch X10 is used to specify the tens and switch X1 is used to specify the units of the device ID.

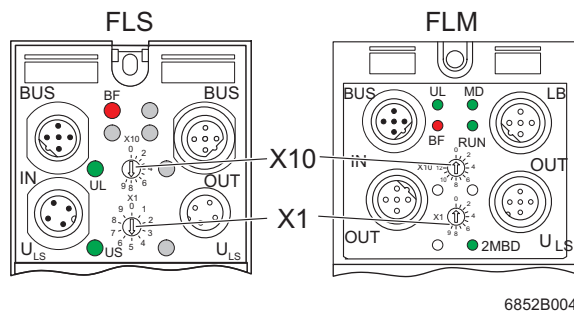


Figure 2-9 Rotary encoding switches

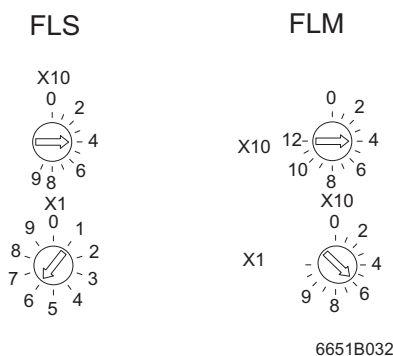


Figure 2-10 Example: Setting address 46



Adjust the rotary encoding switches using a suitable screwdriver (blade width 3.5 mm). Use of an unsuitable tool may damage the rotary encoding switches.



Set the station address immediately after installation and **before** connecting the supply voltages.



The station address, which the PROFIBUS master uses to address the Fieldline Stand-Alone device is set in the range between 1 and 99 using both rotary encoding switches. The station address, which the PROFIBUS master uses to address the Fieldline Modular device is set in the range between 1 and 126 using both rotary encoding switches. Another address cannot be set. Therefore, do not turn rotary encoding switch X10 past position 9 (FLS) or 12 (FLM). The station address set is read upon system startup and accepted in the device settings.



Changing the switch positions during operation has no effect on the address settings. A new address value is only accepted upon device power up. Dynamic address modification via the fieldbus is not supported.

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3 Configuration and Startup

3.1 Configuring the PROFIBUS-DP System

To configure your system, proceed as follows:

- Describe and define the task
 - Specify the device range for the I/O devices
 - Specify the type and number of input and output signals
- Select the devices required
 - Specify the devices to be installed according to the input and output signals
- Consider the system restrictions
 - Take into account the basic system specifications (see Table 1-1 on page 1-4)
- Select the voltage supply
 - Please refer to the information on the power supply in the FLS FLM SYS INST UM E user manual (Order No. 26 98 97 3)
 - The selection of suitable voltage supplies always depends on the particular system. The following criteria should always be met for the 24 V DC voltage supply:

Nominal value:	24 V
Tolerance:	±25% (complies with EN 61131-2: -15% / +20%)
Incl. Ripple:	±5%

This corresponds to a range of 18 V to 30 V (ripple included)



A selection of suitable voltage supplies can be found in the INTERFACE catalog from Phoenix Contact.

- Select PROFIBUS cables



For interference-free transmission Phoenix Contact recommends a 2-wire, twisted pair and shielded cable, specified as cable type A in EN 50 170 Part 8-2. The cable type B which is also described must not be used anymore.

- Select the type of connections for the cables to the devices (BUS IN/BUS OUT or T-pieces (for FLS devices only), see section "Connecting the Bus" on page 2-5)
- Please observe the notes in section "Laying the PROFIBUS Cable" on page 1-6.

3.2 Installation



Disconnect the power supply before installing the devices.

- Installing devices
See FLS FLM SYS INST UM E user manual.
- Connecting the Bus
See section "Connecting the Bus" on page 2-5.
- Installing mains termination resistors
See section "Mains Termination Resistors" on page 1-6.
- Setting the address
See section "Setting the Address" on page 2-7.
- Connecting the supply voltage
See FLS FLM SYS INST UM E user manual.

3.3 Configuration and Startup Using the STEP 7® SIMATIC® Manager

This section describes an example of configuration and startup using the STEP 7® SIMATIC® Manager (English Version 5.1 + Service Pack 3, Release K5.1.3.0). You can apply the procedures to other similar software.

Requirements

- PROFIBUS network is installed
- Termination resistors are specified
- PROFIBUS addresses on the device are set
- Baud rate is specified



If FLM devices with a data width of less than 5 bits and with the same ID and length code are connected next to each other, they are automatically packed during auto configuration, i.e., their data is combined. If you carry out the configuration yourself using a hardware configurator, e.g., the Siemens STEP 7® SIMATIC® Manager, the automatic configuration in the station is overwritten.

Starting the STEP 7® SIMATIC® Manager

Start the STEP 7® SIMATIC® Manager under Windows.

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Creating a new project

Call the "New" dialog box using the "File...New" menu item. Enter the desired name. In this example, the name "Example" has been chosen. If necessary, change the project type and storage location.

Confirm the entry with "OK" or "Return".

The project "Example" is saved.

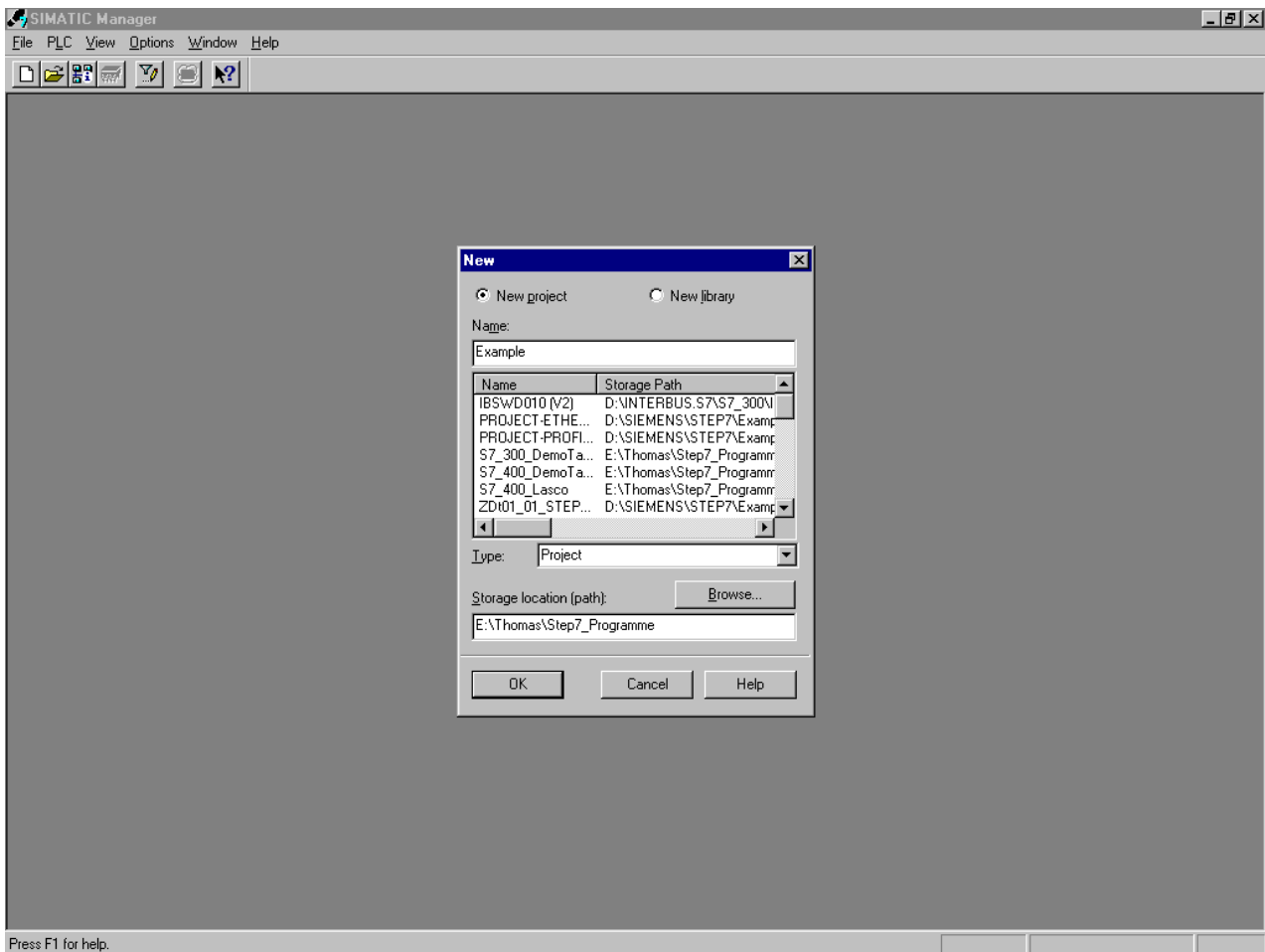


Figure 3-1 Creating a new project

Configuration and Startup

Inserting a new SIMATIC® S7® station into the project

Insert a station using the "Insert...Station...SIMATIC® 300 Station" menu item.
In this example, a "SIMATIC® 300 Station" has been selected.

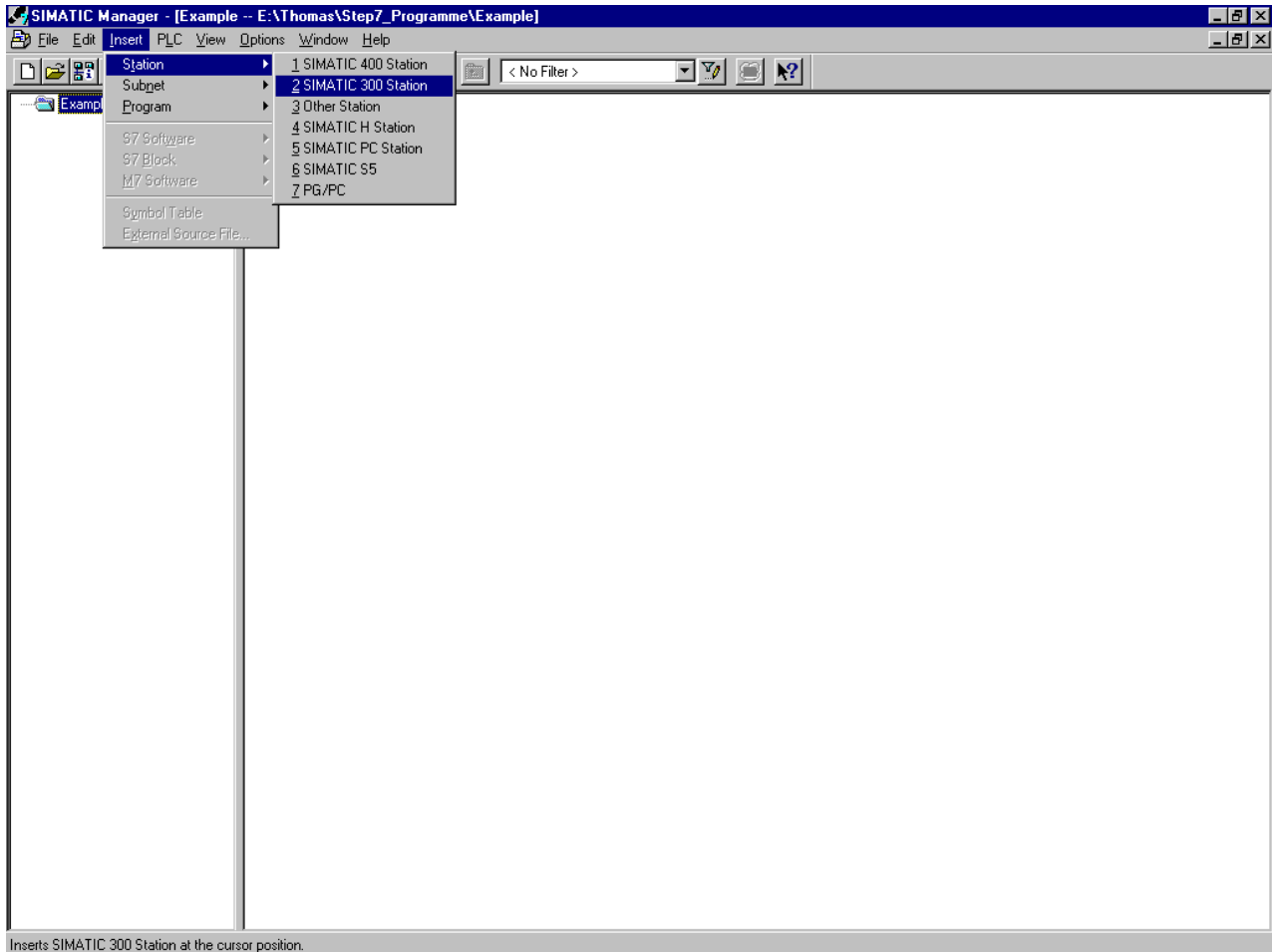


Figure 3-2 Inserting a new SIMATIC® S7® station into the project

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On the left-hand side of the project window, click on the small "plus" box next to the "Example" folder and select "SIMATIC® 300(1)".

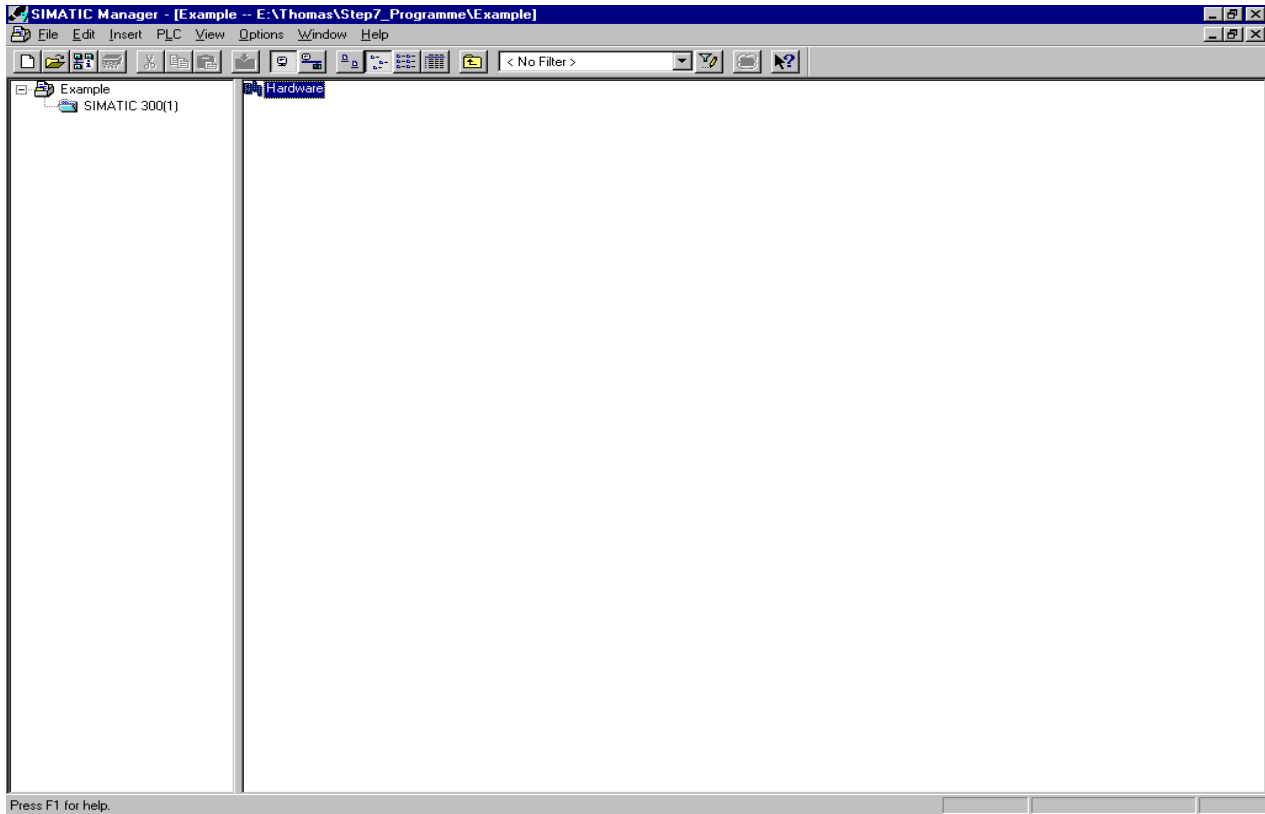


Figure 3-3 Selecting SIMATIC® 300(1)

The SIMATIC® Manager displays the "Hardware" object in the right-hand window.

Double-click on "Hardware" to start the hardware configurator, which can be used to edit the configuration table.

Configuration and Startup

Installing a new GSD file

The characteristic communication features of a PROFIBUS-DP device are defined in the form of an electronic device data sheet (**G S D**, device database file). The GSD file for the Fieldline devices can be found on the Internet at www.phoenixcontact.com.

If this file is not in the system, you must import the file into your configuration program.

Open the "PXC_07E9.gsd" file via "Tools... Install New GSD..." in the dialog box that appears.

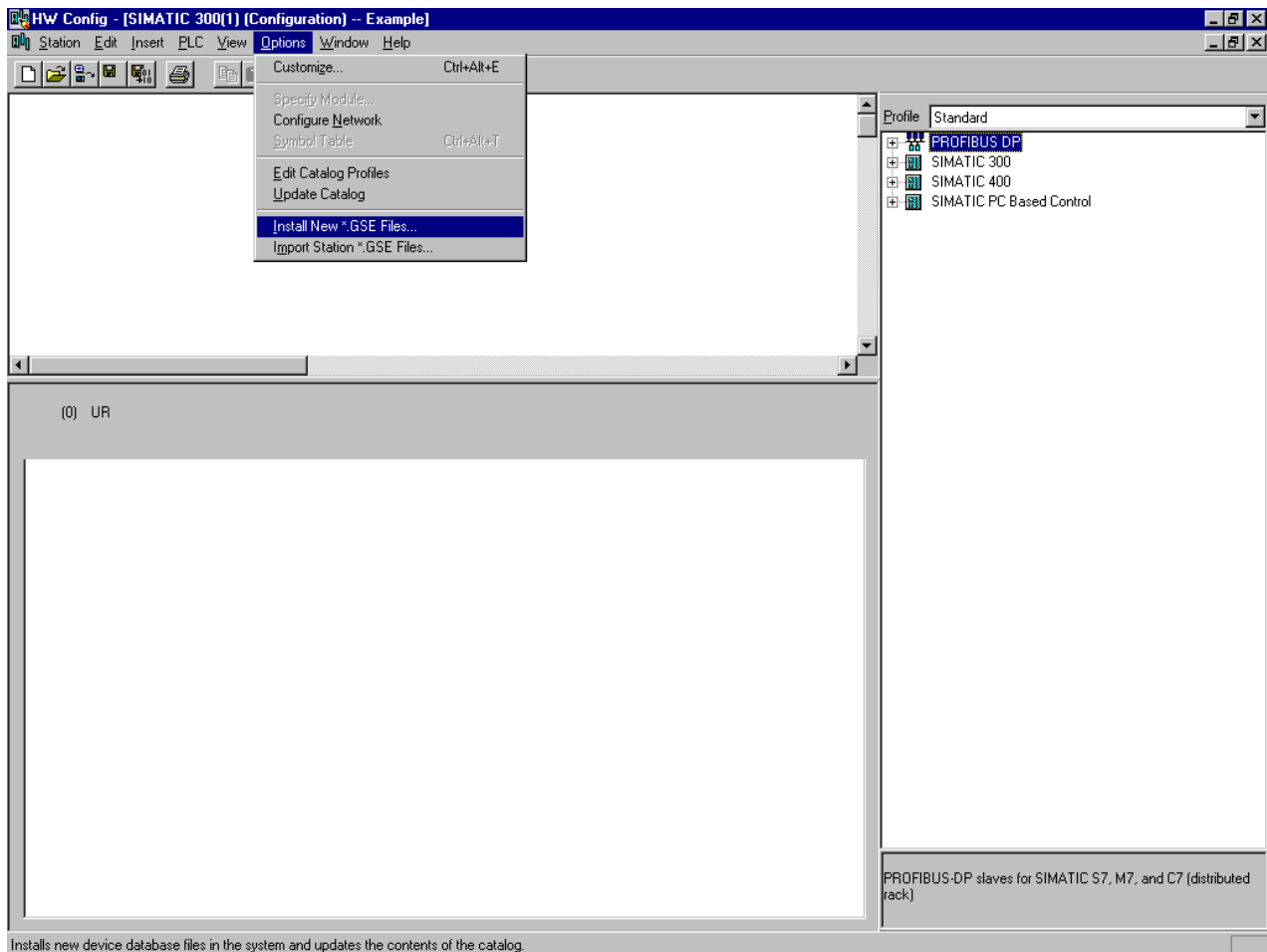


Figure 3-4 Installing a new GSD file

The new GSD file is loaded in the appropriate directory and the hardware catalog is updated.

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Selecting DIN rail and power supply

Now select the DIN rail and the power supply.
For the corresponding procedures, please refer to your STEP 7® SIMATIC® Manager user manual.

Selecting the CPU

Now select the CPU by double-clicking on the CPU folder in the right-hand window (1): "CPU 315-2DP" in this example.

Click on the "New" button in the "Properties - PROFIBUS Interface DP Master (R0/S2.1)" window. (2).

Enter the name (in this example "Sample project") in the "Properties - New Subnet PROFIBUS" dialog box (3), and confirm the entry with "OK" or "Return".

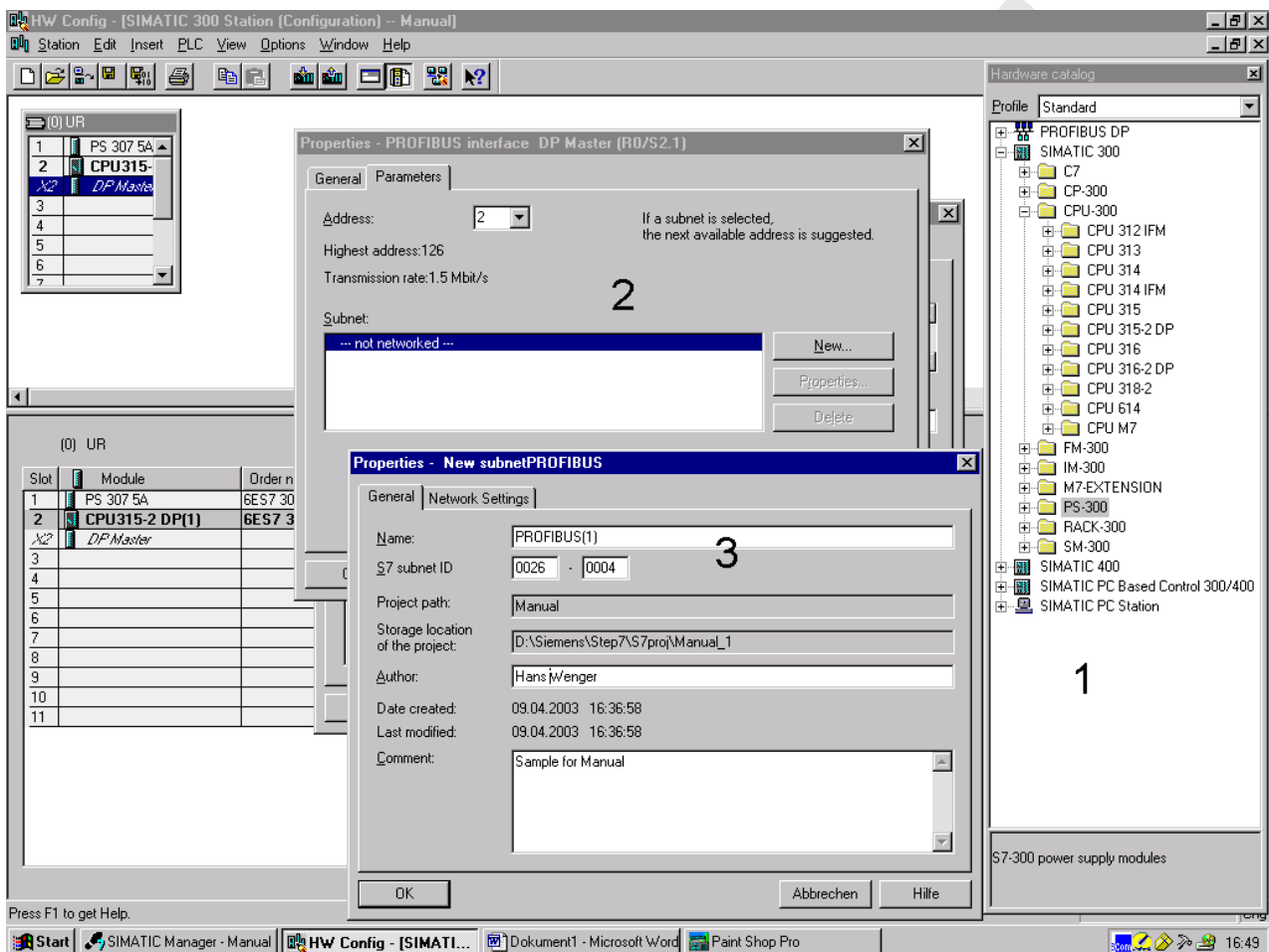


Figure 3-5 Selecting the CPU

Configuration and Startup

Next confirm the entries in the "Properties - PROFIBUS Interface DP Master (R0/S2.1)" window with "OK" or "Return".

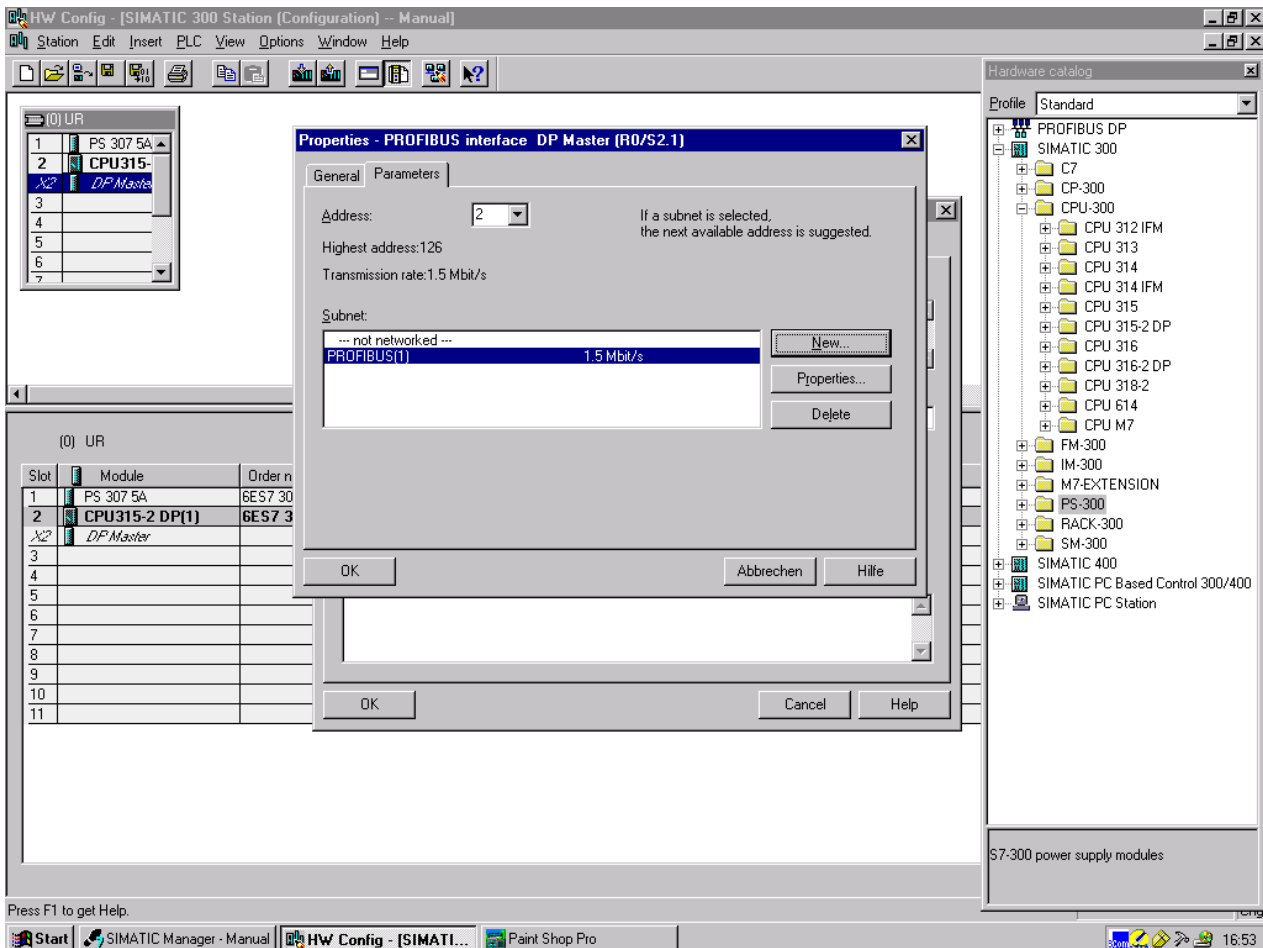


Figure 3-6 Properties - PROFIBUS Interface DP Master (R0/S2.1)

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Select PROFIBUS FLM bus coupler

Click on "Sample project: DP master system". (1)

Click with the mouse in the free slot. (2)

Select the FLM bus coupler from the hardware catalog (3) in the "PROFIBUS-DP... menu Additional Field Devices... I/O... Phoenix Contact... FIELDLINE... FLM BK PB M12 DI 8 M12" by double-clicking on FLM BK PB M12 DI 8 M12.

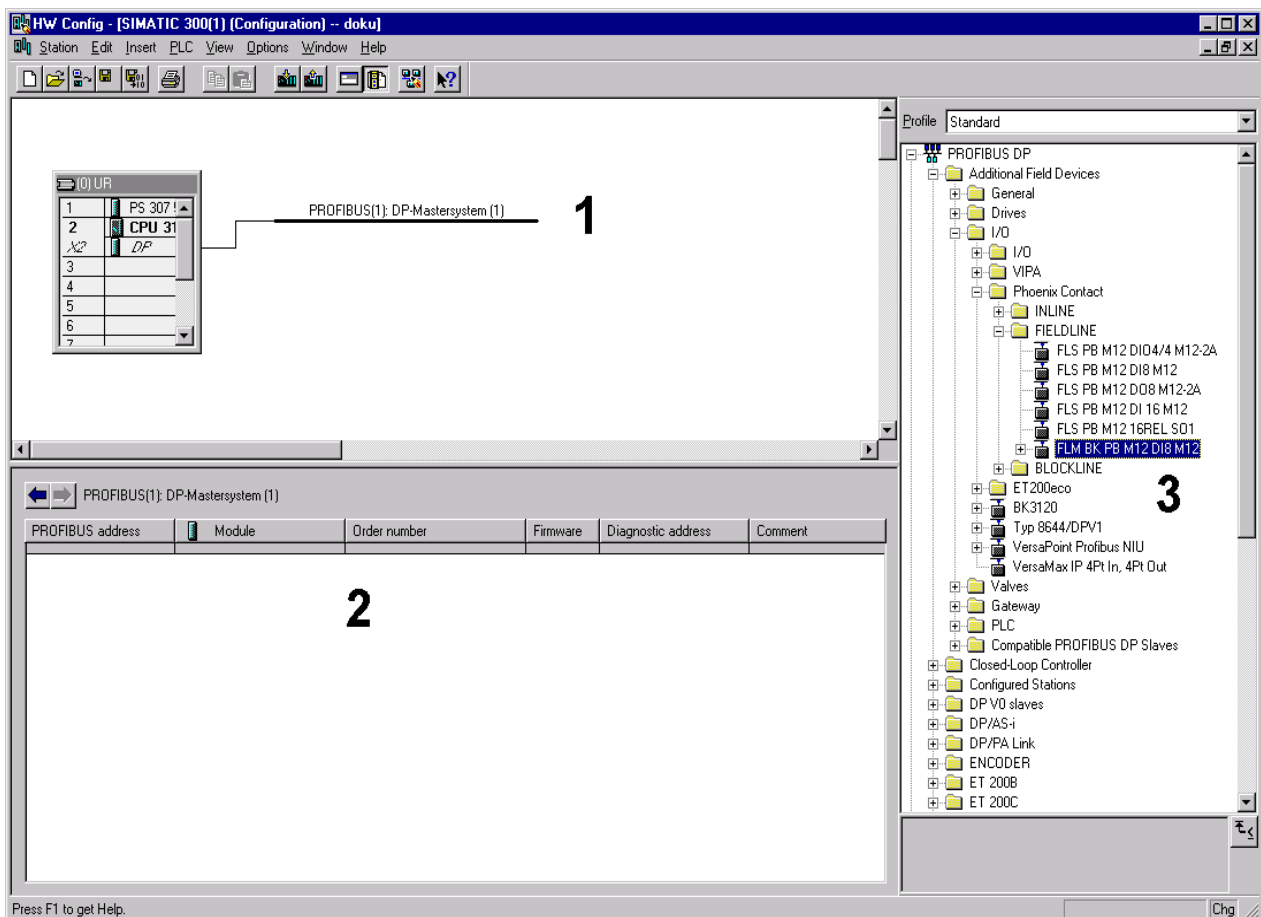


Figure 3-7 Select the FLM bus coupler

Configuration and Startup

The "Features - PROFIBUS interface" window opens
FLM BK PB M12 DI 8 M12.

Check the PROFIBUS address of the bus coupler in the dialog field, and if required, adjust this according to the application. Confirm your entry with "OK".

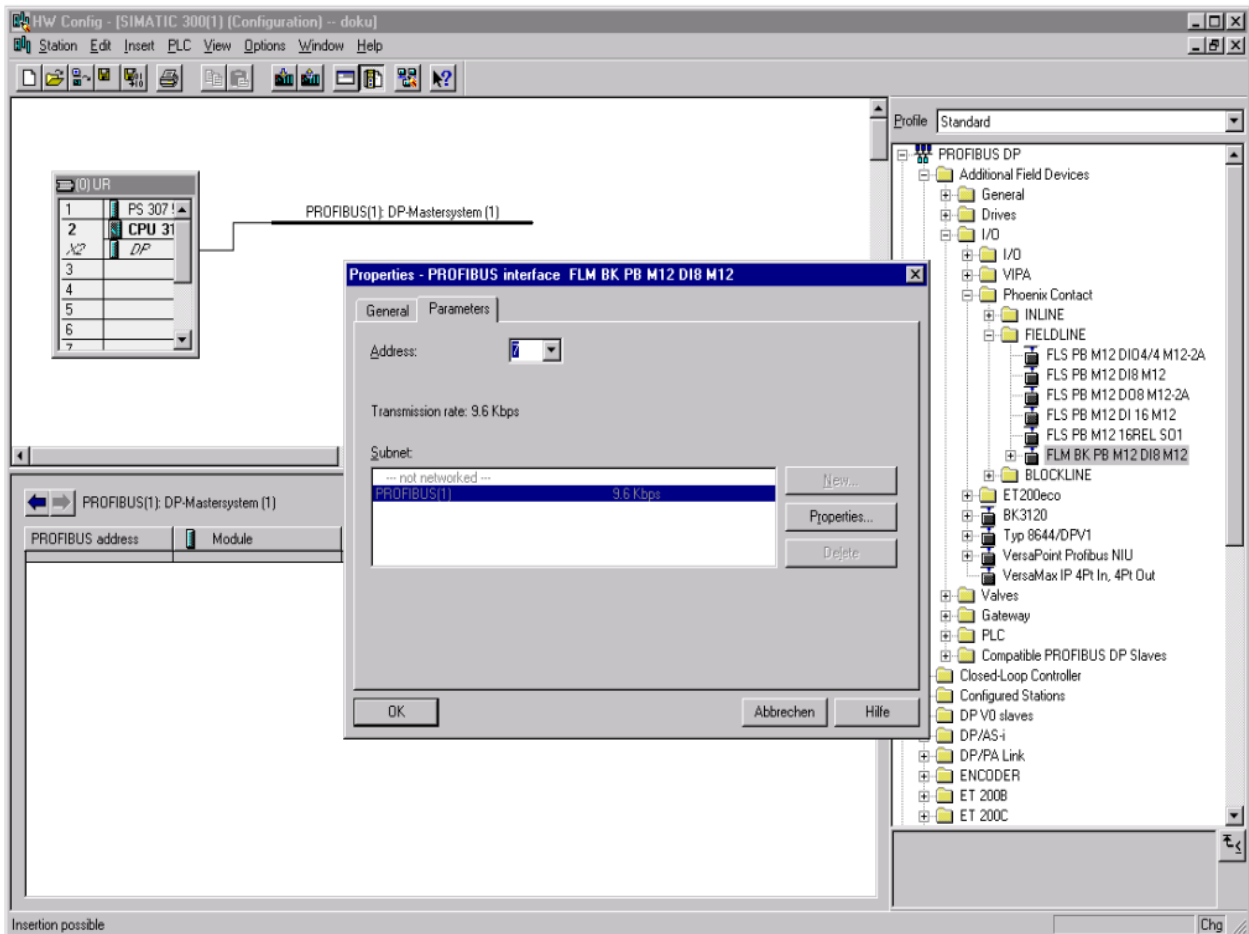


Figure 3-8 Properties - PROFIBUS Interface
FLM BK PB M12 DI 8 M12

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Positioning the bus coupler

Select the bus coupler by clicking on the bus coupler icon using the mouse. (1)

Select a free slot/line by clicking with the mouse in a free slot/row. (2)

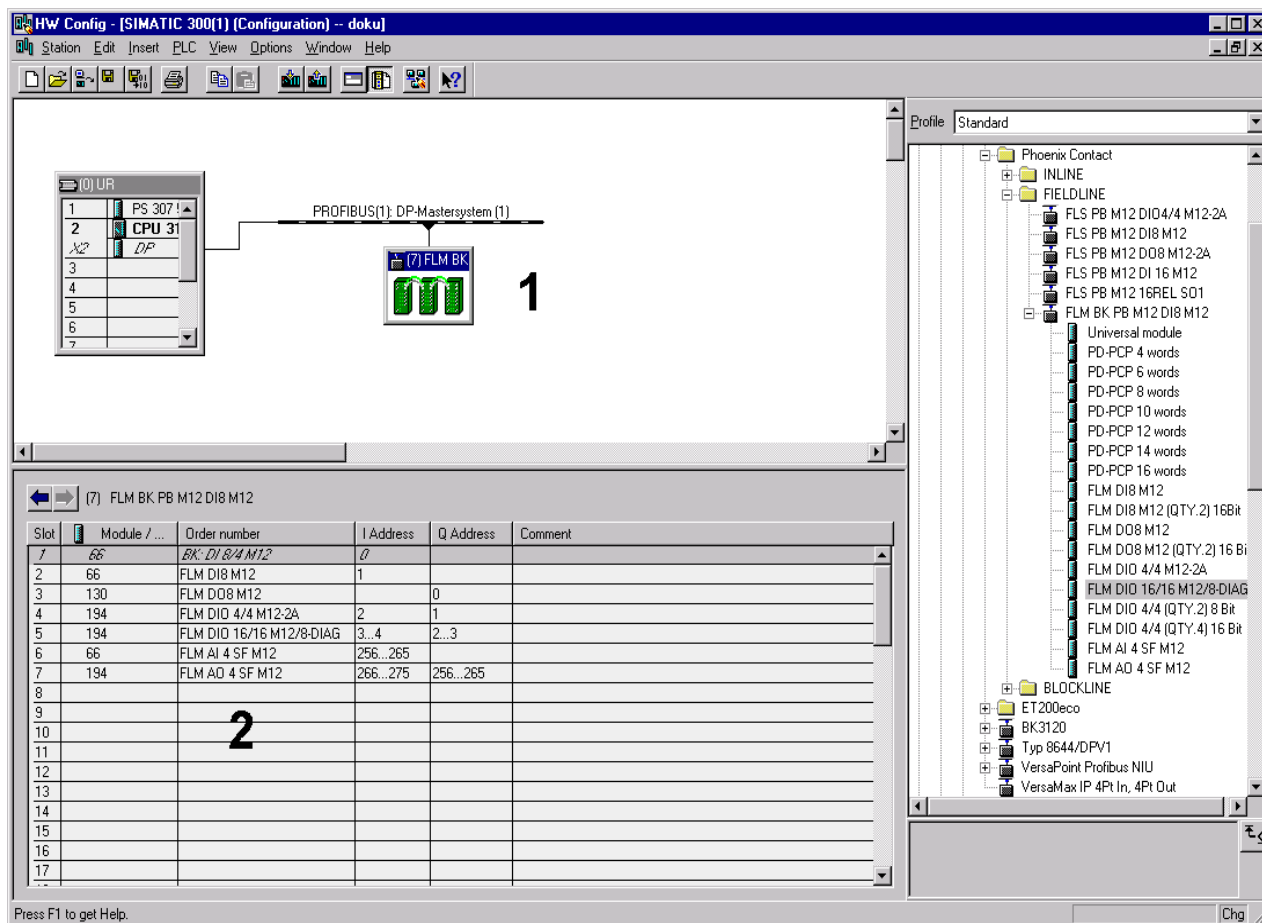


Figure 3-9 Positioning the bus coupler

The FLM components can now be selected from the hardware catalog and assigned to the bus coupler according to their physical position in the sequence (drag & drop).



If the FLM BK PB M12 DI 8 M12 device is not automatically inserted into the first position by the hardware configurator, please manually select it from the hardware catalog.

Configuration and Startup

If necessary, the I/O addresses can be changed by double-clicking on the rows of the FLM components. Entries can be made in the "Properties - DP Slave" dialog box. Confirm your entries with "OK" or "Return".

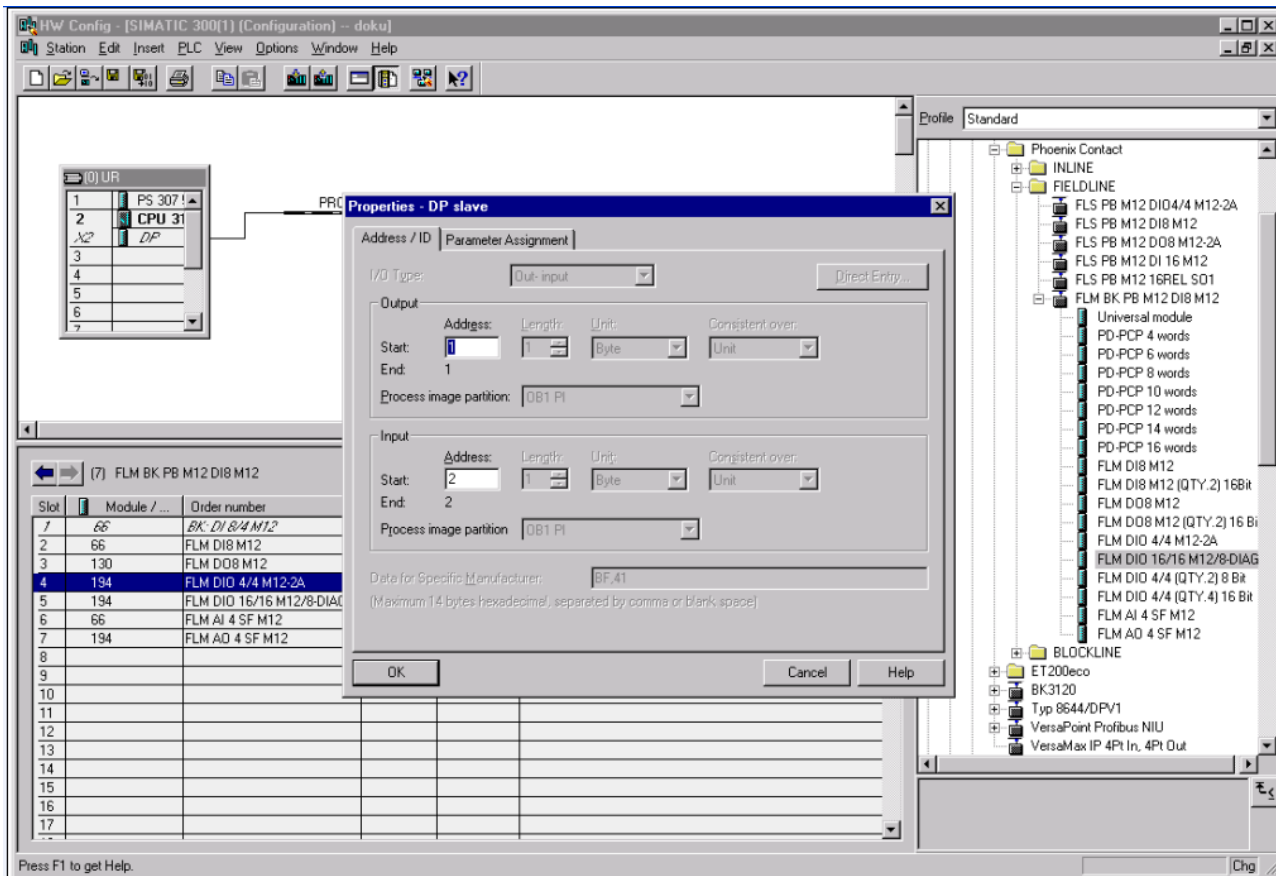


Figure 3-10 Checking or changing I/O addresses

It is possible to connect additional PROFIBUS DP devices to the DP master system - in this case "Example" - and parameterize and address each one according to the device type.

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Transfer to the S7 system

Save and translate the project using the  button or the "Station... Save and Translate" menu item.

Transfer the project to the S7 system using the  button or the "Target System... Load to Module" menu item.

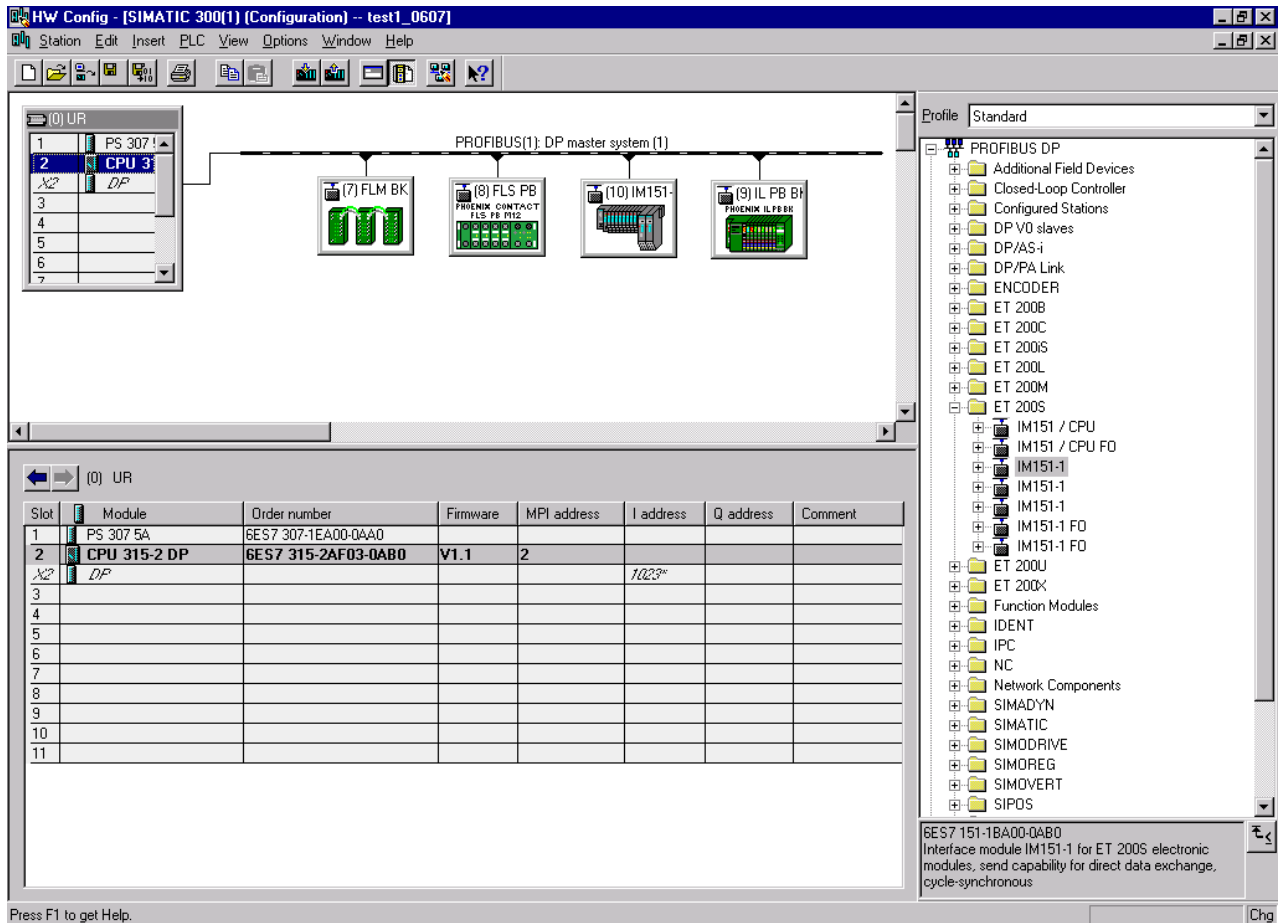


Figure 3-11 Connecting additional devices to the DP master system and downloading them

After data transmission is complete, the PROFIBUS system starts automatically.

3.4 Functions of the FLM BK PB M12 DI 8 M12

3.4.1 Parameters

Besides the PROFIBUS standard functionalities, you have the possibility to select different additional functions in the "Parameterize" dialog of your configuration tool after having imported the GSD file as well as the configuration of the station.

I/O parameters

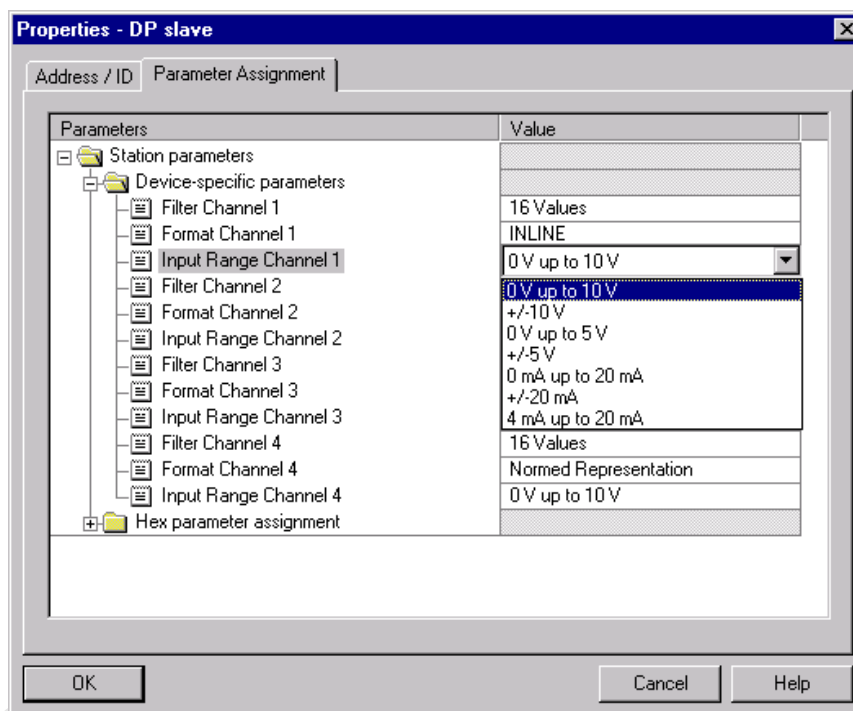


Figure 3-12 Parameters for the FLM AI 4 SF M12 device

Especially for the analog I/O devices you have the option to set parameters in order to adapt the device to the individual requirements. For example, you could preset a measuring range or a data format. This option is prepared in the GSD file and can be accessed under the features of the corresponding I/O device.

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Replacement strategy in local bus

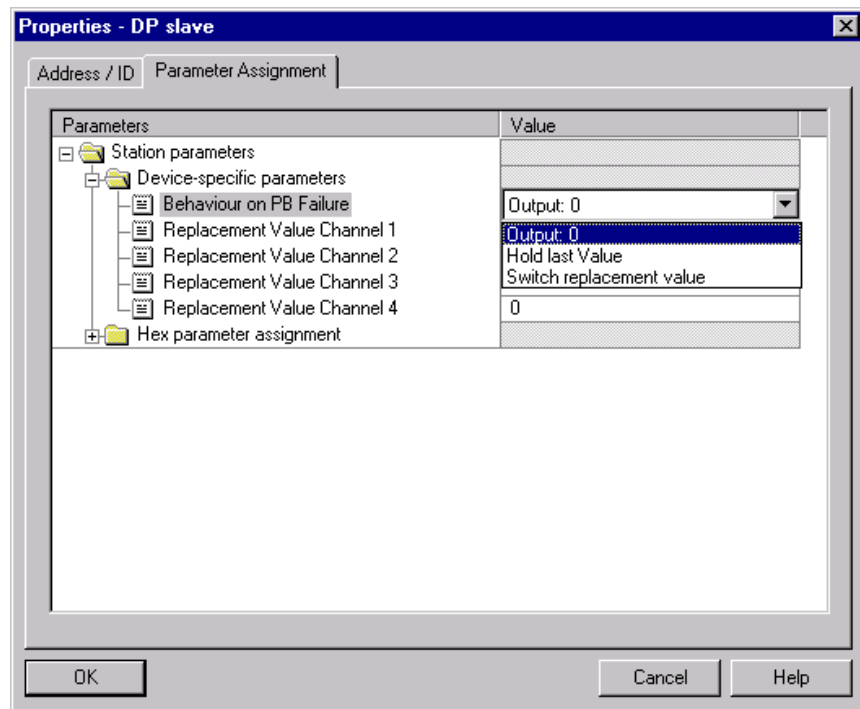


Figure 3-13 Presetting substitute values

During errors in PROFIBUS or when the control system fails you can check the correct future behavior of the outputs.

Here you have the following options:

- output of the value 0,
- maintains last value,
- select substitute value (can be set).



The response monitoring on the slave must be activated so that the settings are activated.

Configuration and Startup

Adapting the data format to the control system

When using 16-channel digital devices, you have the possibility to adapt the data format to the control system. Here, the inputs and outputs of the connectors 1 to 4 and 5 to 8 can either be copied onto byte 1 and byte 0 or the other way around, i.e. connector 1 to 4 and 5 to 8 are copied onto byte 0 and 1.

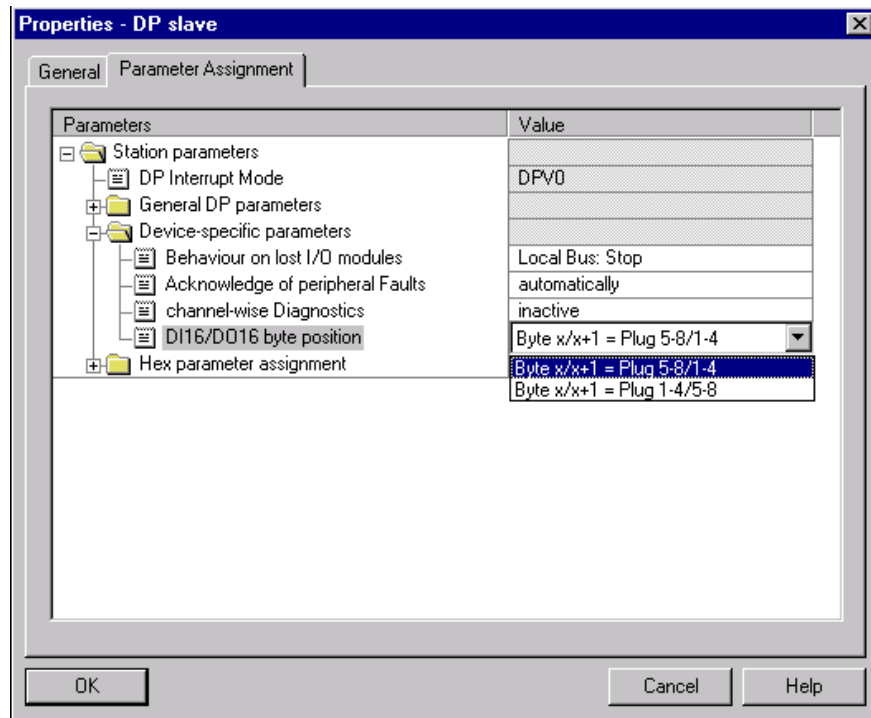


Figure 3-14 Adapting the data format to the control system

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Operation during device failure on the local bus

In the event of a device failure in the local bus you can either continue to operate the remaining still available devices or you can stop the local bus until all devices are available.

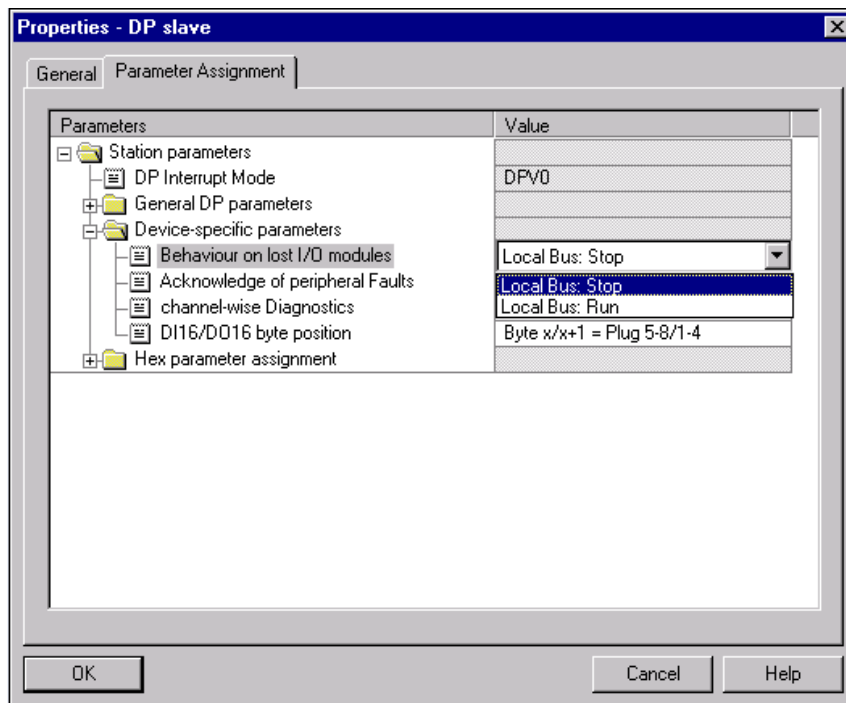


Figure 3-15 Operation during device failure on the local bus



If you select restart using those devices that are still available, please note that the outputs will be temporarily reset during a restart. With the "Stop" setting, the local bus only starts if the configuration corresponds to the presetting.

Configuration and Startup

Acknowledging I/O errors

This option has been prepared for future I/O devices. If you are using a device where those I/O errors will be reported that have to be acknowledged, this message can either be acknowledged automatically or from the application.

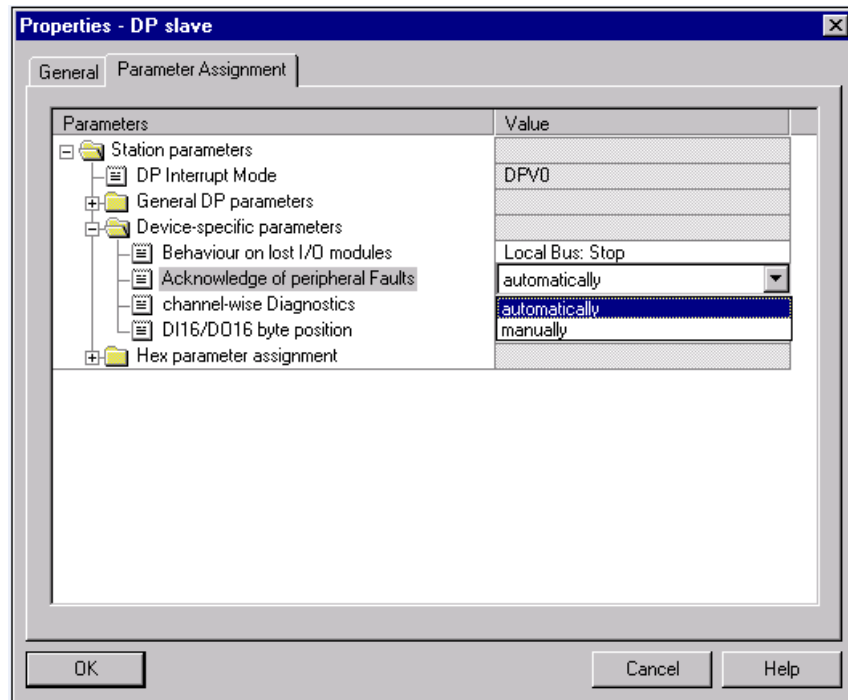


Figure 3-16 Acknowledging I/O errors

Channel-Specific Diagnostics

Several devices support channel-specific diagnostics. If you would like to read them, if required, please enable the diagnostics here. Please note that this procedure lengthens the diagnostic telegram. Up to 10 diagnostics will be displayed simultaneously.

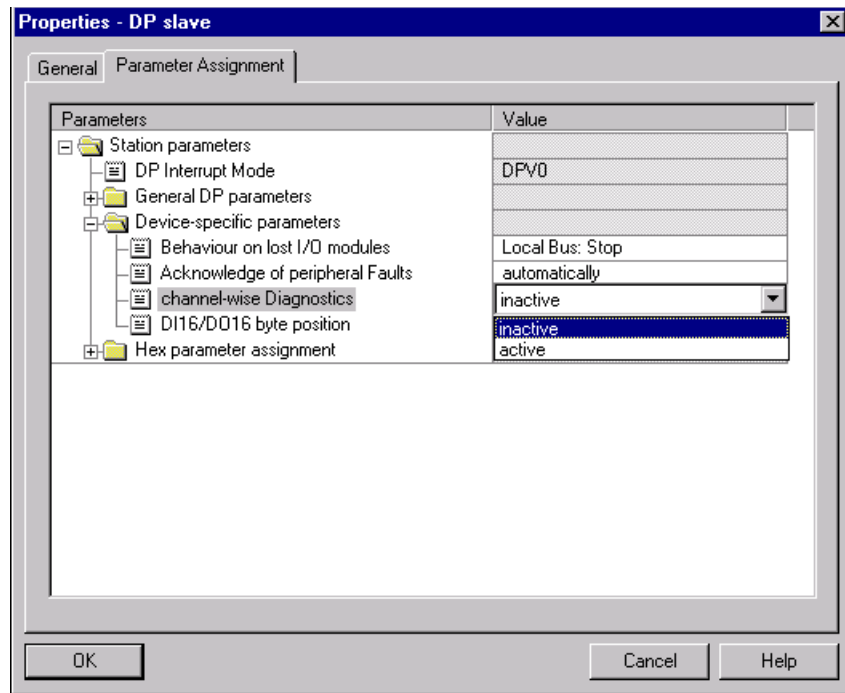


Figure 3-17 Setting the channel-specific diagnostics

3.4.2 Local Diagnostic and Status Indicators

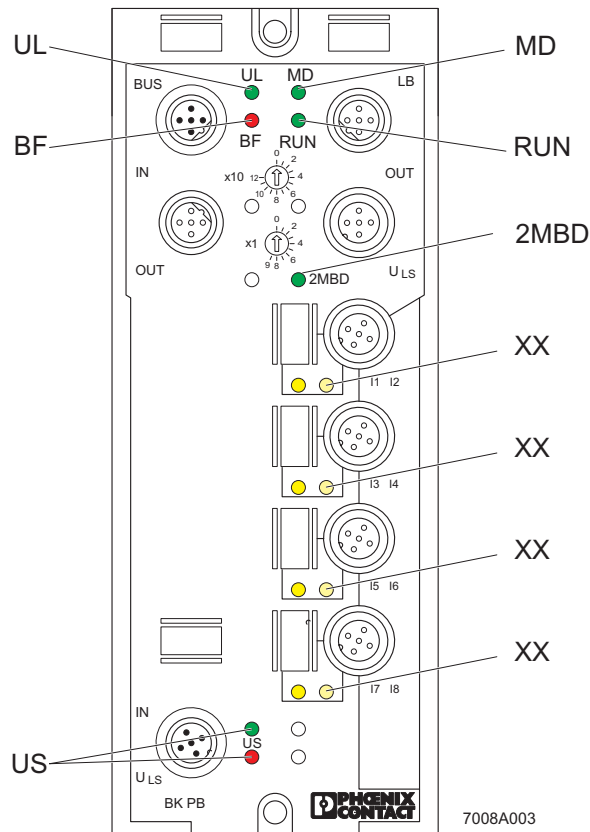


Figure 3-18 Diagnostic and status indicators of the FLM BK PB M12 DI 8 M12 device

Table 3-1 Diagnostic and status indicators

Des.	Color	Meaning
UL	Green LED	Communications power
	ON:	Communications power present
	OFF:	Communications power too low

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Des.	Color	Meaning
BF	Red LED	No cyclic data transmission: PROFIBUS not connected, master not active Incorrect settings (configuration via master, station address) Timeout expired
	LED OFF:	The device is addressed by the PROFIBUS, it received a parameterization No power supply for the device (In this state the "UL" LED does not light up either because of the missing 24 V communications power.)
MD	LED green/red/yel- low	Device status
	Green ON:	Device is ready to operate.
	Green, flashing: 1 Hz	An error is present that can be corrected (local bus not complete). Station in process data mode.
	Green/red Flashing (flicker)	Device in selftest state.
	Red ON	An error is present that cannot be corrected.
	Red flashing: 1 Hz	Local bus is read, no process data transmission on local bus.
	Yellow flashing: 1 Hz	More than 64 devices configured or system restriction of 244 bytes of process data/configuration data exceeded.
	OFF:	Voltage not present.
RUN	LED green/red/yel- low	Status of local bus communication
	Green ON	Local bus is running data cycles.
	Green, flashing: 1 Hz	I/O error present.
	Red ON	Local bus stopped.
	Red/yellow Flashing: 1 Hz	There are differences between specified and current configuration.
	Flashing green/yellow: 1 Hz	Pre-programmed error values are written to the outputs. PLC stopped or PROFIBUS connection interrupted (cable, connector).
	Yellow flashing: 1 Hz	PCP error on an I/O device
	OFF:	Voltage not present.
US	Green/red LED	Voltage supply for inputs IN1 to IN8
	Green ON:	Voltage supply present.
	Red ON:	Overload or voltage supply too low.
	OFF:	Voltage supply not present.

3.5 Diagnostics

Table 3-2 Diagnostics FLM BK PB M12 DI 8 M12

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Meaning
								Station status 1
								Station status 2
Byte 1 to 3 PROFIBUS standard								Station status 3
								PROFIBUS master address
0	0	0	0	0	1	1	1	Manufacturer ID high-byte (07 _{hex})
1	1	1	0	1	0	0	1	Manufacturer ID low-byte (09 _{hex})
0	1	L = Block length						ID-specific diagnostics (Header)
LT 8	LT 7	LT 6	LT 5	LT 4	LT 3	LT 2	LT 1	Local bus device 1 to 8
LT 16	LT 15	LT 14	LT 13	LT 12	LT 11	LT 10	LT 9	Local bus device 9 to 16
...	...	...	...	...	...	...	...	...
0	LT 63	LT 62	LT 61	LT 60	LT 59	LT 58	LT 57	Local bus device 57 to 63
0	0	L = Block length						Status (header)
1	0	0	0	0	0	1	0	Status type = device status
0	0	0	0	0	0	0	0	Slot (= 0 = general status of the bus coupler)
0	0	0	0	0	0	SP	SP	Specifier
ST LT 4		ST LT 3		ST LT 2		ST LT1		Status, local bus device 1 to 4
ST LT 8		ST LT 7		ST LT 6		ST LT 5		Status, local bus device 5 to 8
...	...	...	...	...	...	...	...	...
0		ST LT 63		ST LT 62		ST LT 61		Status, local bus device 61 to 63
1	0	Slot						Channel-specific diagnostics (header) #1
IO		Channel						IN / OUT and channel number #1
CT			ET					Channel and error type #1
1	0	Slot						Channel-specific diagnostics (header) #2
IO		Channel						IN / OUT and channel number #2
CT			ET					Channel and error type #2

10 channel-specific diagnostics, maximum

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Table 3-2 Diagnostics FLM BK PB M12 DI 8 M12

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Meaning
1	1	X	X	X	X	X	X	Revision (start with C1)
0	0	0	0	1	1	0	0	Status (header)
1	0	1	0	0	0	0	0	Reserved (header)
0	0	0	0	0	0	0	0	Reserved (header)
0	0	0	0	0	0	0	0	Reserved (header)
0	0	0	0	0	0	B	B	Baud rate local bus: 1 = 500 kbaud 2 = 2 Mbaud
X	X	X	X	X	X	X	X	Diag Location (FF = OK)
X	X	X	X	X	X	X	X	User ID code, 1st local bus device with error
X	X	X	X	X	X	X	X	User length code, 1st local bus device with error
X	X	X	X	X	X	X	X	LB state (high byte)
X	X	X	X	X	X	X	X	LB state (low byte)
0	0	0	0	0	0	0	X	System limit violated?
X	X	X	X	X	X	X	X	Number of accessible local bus devices

Block 1: PROFIBUS Standard Diagnostics

Block 2: ID-Specific Diagnostics

The table shows the faulty local bus devices. For every faulty device, a "1" is entered.

In the first byte of the block, in bit 0 up to 5 the length L of the entire ID-specific diagnostic block including the header is given. The minimum length of this block is 2, the maximum length is 9. The size of the ID-specific diagnostics block also depends on the number of the configured devices.

Block 3: Status PDU (Device Status)

For every local bus device there are 2 bits for status coding:

ST LT x: 00 = Device data are valid.

ST LT x: 01 = Device data are invalid because of an error.

ST LT x: 11 = Device data are invalid because the wrong module had been connected.

ST LT x: 11 = Device data are invalid or no device has been connected (despite configuration)

The specifier (SP) equals 1 in the event of a faulty state. The specifier equals 2 if the device changes from a faulty into an error-free state. If the specifier equals 0, the state did not change.

Configuration and Startup

- SP: 0 = No evaluation
- SP: 1 = An error occurs (number > 0)
- SP: 2 = An error disappears (number = 0)
- SP: 3 = Reserved

In the first byte of the block, in bit 0 up to 5 the length L of the entire status PDU block including the header is given. The minimum length of this block is 5, the maximum length is 20. The size of the status PDU block also depends on the number of the configured devices.

Block 4: Channel-Specific Diagnostics

Up to 10 channel errors are indicated here. Each channel error is an individual and independent error. The prerequisite for the display of the channel errors is that the I/O device supports PCP and that the channel-specific diagnostics in the bus coupler are enabled.

- IO: 00_{bin} = Reserved
- IO: 01_{bin} = Input
- IO: 10_{bin} = Output
- IO: 11_{bin} = Input and Output

Channel: Channel number of the respective channel (0 up to 63)

- CT: 000_{bin} = Reserved
- CT: 001_{bin} = 1 Bit
- CT: 010_{bin} = 2 Bit
- CT: 011_{bin} = 4 Bit
- CT: 100_{bin} = 1 Byte
- CT: 101_{bin} = 1 Word
- CT: 110_{bin} = 2 Words
- CT: 111_{bin} = Reserved

- ET: 0 = Reserved
- ET: 1 = Short-circuit
- ET: 2 = Undervoltage
- ET: 3 = Surge voltage
- ET: 4 = Overload
- ET: 5 = Overtemperature
- ET: 6 = Cable break
- ET: 7 = Upper limit value exceeded
- ET: 8 = Lower limit value exceeded
- ET: 9 = General error

Block 5: Revision Diagnostics

Block 6: Status PDU

The sixth block also is encoded as status PDU, however, in manufacturer-specific format. The information stored here usually needs not be evaluated.

Byte 5 indicates the baud rate with which the local bus is operated and it indicates the status of pin 5 of the U_{LS} power supply (1 = 500 kbaud, 2 = 2 Mbaud).

Byte 7 and byte 8 show the ID and length code of the first faulty devices. This can be used as additional information for blocks 2 and 3, if required.

The value of byte 11 is 1, if the system limit was exceeded.

Byte 12 indicates the number of available devices.



The FLM BK PB M12 DI 8 M12 is always counted as local bus device (LT). If an error occurs on this device, the corresponding bits in the diagnostics are set for local bus device 1.

3.6 Object Dictionary

3.6.1 Slot 0

On slot 0, the following station-specific indices are implemented:

Index 3: PDU Length

Function: Data width of the virtual C1 module (process data interface for acyclic communication) in bytes

Access: Read

Length: 1 bytes

Note: For DP/V0 access only

Index 4: Master Control

Function: Control bits for station

Access: Write

Length: 1 bytes

Structure: Bit 0: Restart local bus
Bit 1: Acknowledge PF
Bit 2: Update diagnostics (evaluation of index 18 on PCP devices)
Bit 3: Unlock dynamic configuration
Bit 4: Reserved (set to 0)
Bit 5: Reserved (set to 0)
Bit 6: Reserved (set to 0)
Bit 7: Reserved (set to 0)

With the help of bit 0, the local bus can be restarted anytime. If a new activation status has been given via index 6, it is used for this restart. Please note that during reset the device output data are reset to their device-specific reset values.

With bit 1, errors that have to be acknowledged can be set back. This function has been prepared for future devices.

Set bit 2 if the diagnostics of all connected devices is to be read in again. This option is only useful, if those devices are connected where object 18_{hex} (Diag State) is implemented. Usually this includes all Fieldline Modular devices using PCP. For this reason, check in the respective data sheet whether the device supports PCP.

Bit 3 can be used in the context of dynamic configuration. If a new activation status has been given via object 6 or 7 it is obligatory. If in the course of this, the connection to the PROFIBUS master is interrupted and if the original parameterization is transmitted by the master during restart, the activation status is maintained. The dynamic configuration needs not to be executed again.

However, if the activation status is set back during restart, set bit 3 once after having executed a dynamic configuration via index 6 or 7.

In this way, both possibilities are available:

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- Restart with original configuration
- Restart with the latest dynamic configuration

Index 5: PCP Status

Function: Position and communication status PCP devices

Access: Read

Length: 3 bytes per PCP device -> maximum 48 bytes

Structure: Byte 1: Position in the station (slot number)
 Byte 2: Status of PCP connection

- 00_{hex} no connection
- 01_{hex} connection ok
- FF_{hex} error during connection establishment

Byte 3: Reserved

Index 6: Enabling a Device

Function: De-/activating I/O devices

Access: Read and write

Length: 8 bytes

Structure:

Byte 1								Byte 2								Bytes 3 to 7	Byte 8							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	...	57	58	59	60	61	62	63	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

Configuration and Startup

Index 7: Activating a Device / Restart

Function: De-/activating I/O devices, bus restart (write), number of devices and status (read)

Access: Simultaneously read and write via DP/V0 with command 08

Length: 3-byte header, 1-byte length specification, up to n= 8 bytes for up to 63 devices

Structure:

Write:

Byte 1	08 _{hex}							
Byte 2	00 _{hex}							
Byte 3	07 _{hex}							
Byte 4	Length of the following data n							
Byte 5	1	2	3	4	5	6	7	8
...								
Byte 4+n	x	x	x	x	x	x	x	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

Read (Write-Response):

Byte 1	88 _{hex}							
Byte 2	Status							
Byte 3	Length of the following data m							
Byte 4	Number of accessible devices (k)							
Byte 5	1	2	3	4	5	6	7	8
...								
Byte 3+m	x	x	x	x	x	x	x	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

This object is especially intended for use under DP/V0. The data length of the write is always depending on the number of configured devices. In this context, the number of de-/activated devices is entirely irrelevant. If e.g., you configured 15 devices, 4 of which are to be deactivated and 11 of which are to be activated, only the number of configured devices is relevant. In this case you would need 2 bytes in order to display 15 devices. If 25 devices are configured, you will need 4 bytes. On a write action, at least as many bytes are to be used that the activation status for each device can be transmitted. It is also possible to transmit more bytes. However, only up to 8 bytes can be transmitted because the station can only manage a maximum of 63 devices.

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On read action, the number of data specifies the number of configured and accessible devices. If e.g., $k = 18$ devices are configured, you will receive the response $m = 3+1$ byte.

The following is valid for bytes on and behind position 5:

Status and specification are identical:

Activated and connected: Write: "1"; Read: "1"

Not activated and not connected: Write: "0"; Read: "0"

Status and specification in conflict:

Activated but not connected: Write: "1"; Read: "0"

Not activated but connected: Write "0"; Read: "1"

Since the specification must be identical with the connected devices, you can derive from the comparison of the desired state in the output data with the real state in the input data and a simple specification of the activation whether and which devices are present or not.

An example for the access onto index 7 is illustrated in section 5.3.3 on page 5-7 pp.

Index 12: Device Diagnostics

Function: Station diagnostics starting with byte 7 (without standard diagnostics)

Access: Read

Length: 72 bytes, maximum

Structure: As described in section "Diagnostics" on page 3-23

Index 20: Cycle Count

Function: Cycle count (all cycles)

Access: Read and write

Length: 8 bytes

Note: For write, all counters are set to 0 (index 20 to 25)

Index 21: Cycle Error Count

Function: Cycle count (all faulty cycles)

Access: Read and write

Length: 8 bytes

Note: For write, all counters are set to 0 (index 20 to 25)

Index 22: ID Cycle Count

Function: Cycle count (all ID cycles)

Configuration and Startup

Access: Read and write
Length: 8 bytes
Note: For write, all counters are set to 0 (index 20 to 25)

Index 23: ID Cycle Error Count
Function: Cycle count (all faulty ID cycles)
Access: Read and write
Length: 8 bytes
Note: For write, all counters are set to 0 (index 20 to 25)

Index 24: Data Cycle Count
Function: Cycle count (all data cycles)
Access: Read and write
Length: 8 bytes
Note: For write, all counters are set to 0 (index 20 to 25)

Index 25: Data Cycle Error Count
Function: Cycle count (all faulty data cycles)
Access: Read and write
Length: 8 bytes
Note: For write, all counters are set to 0 (index 20 to 25)

The objects on slot 0 can be read and written via one individual access via DP/V1.

3.6.2 Slot 1

On slot 1, indices are implemented with regard to the integrated DI 8.

Index 13:	PD-IN
Function:	Input data of the integrated DI 8
Access:	Read
Length:	1 bytes

3.6.3 Slot 2 to 63

On slot 2-63, indices are implemented with regard to connectable I/O devices:

Index 13:	PD-IN
Function:	Input data on the slot of connected devices
Access:	Read
Length:	0 up to 128 bytes
Index 47:	PCP Access
Function:	Read and write of PCP data on connected devices via DP/V1
Access:	Read and write
Length:	Depending on the command and the PCP object
Structure:	See section 4.4 on page 4-6 pp.
Note:	During access via DP/V0, the PCP objects can be accessed directly via index 47.

4 Acyclic Communication (DP/V1 and PCP)

DP/V1

DP/V1 expands the cyclic data exchange function according to IEC 61158 to include acyclic services. This makes it easy to operate even complex devices.

PCP

PCP is used in the local bus to exchange data acyclically. Usually parameterization data of complex devices or data with variable length (e.g., FLM DIO 16/16 M12/8-DIAG) are used.

DP/V1 is a mechanism which corresponds to PCP and PROFIBUS.

The FLM BK PB M12 DI 8 M12 bus coupler prepares the data records, which are sent via DP/V1 from the C1 or C2 master, for the PCP mechanism in the local bus. PCP data from the local bus in turn are realized by the bus coupler in DP/V1 telegrams.



Before programming the application, check whether your control system or configuration tool supports DP/V1. If not, you can use the functions offered by the cyclic process data channel (DP/V0), see section 4.5 on page 4-15 pp.

The following decisions must be made regarding communication:

4.1 Acyclic Communication via C1 Master

C1 master

The C1 master carries out parameterization during slave startup and is also the master for cyclic data traffic. It may also be necessary to acyclically read a parameter from the device as an option using this C1 master.

Corresponding read and write accesses are therefore defined for the C1 master.

As it already has a connection to the slave during cyclic data traffic, the C1 master does not have to establish an explicit connection (using "Initiate"), but can communicate with the slave directly via "Read" and "Write".

4.2 Acyclic Communication via C2 Master

C2 master

For communication in the C2 master, the data fields are identical to those of C1 communication, and it is only the SAPs (Service Access Points) which are different. The additional effort required is the use of "Initiate" and "Abort" to establish and release the connection via SAP49 and 50. If DP/V1 devices are already in use, the routines for connection management can be adapted easily. The C2 master can be implemented in various forms, e.g., in the form of a display device or operator interface. In a display device, the data is fetched from the slave on request if, for example, a specific parameter is to be read. Access to the operator interface is usually acyclic.



You can connect up to 16 PCP-compatible devices to the FLM BK PB M12 DI 8 M12 buscoupler.

4.3 PCP Communication Basics

PCP (Peripherals Communication Protocol) controls the transmission of parameter data in the local bus. Special PCP services are available for this purpose.

Application Example

To explain the basics of PCP communication, the following concrete PCP application is used as an example:

A frequency inverter (FI), together with other field devices, is connected to a PLC via a bus interface. The device versions are standardized according to the drives profile.

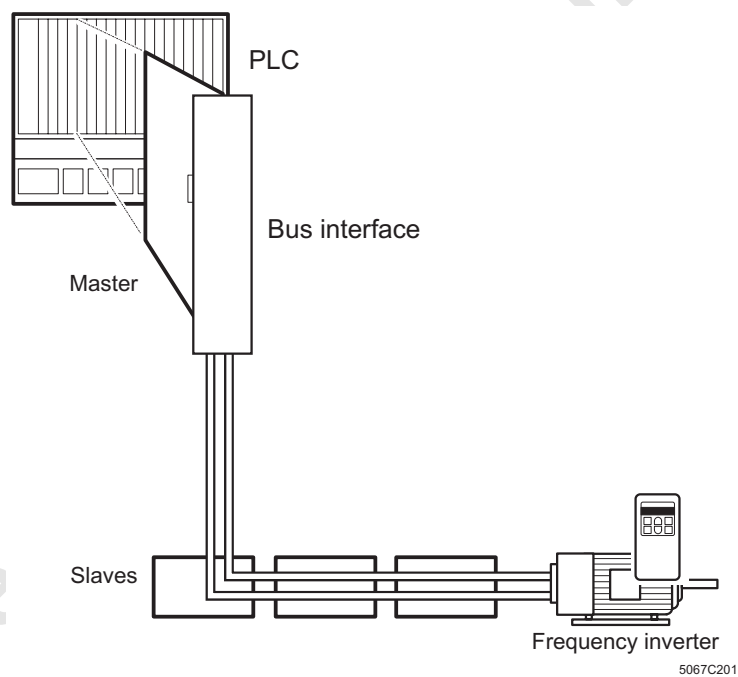


Figure 4-1 Application example

Device parameters

Device parameters are data from intelligent field devices (PCP devices), which is required for the startup phase of machines and systems. Once it has been entered, this data only has to be modified upon a change in the parameterization or in the event of an error. The parameters are pre-configured and can be taken from the device documentation provided by the manufacturer.

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Parameters of a frequency inverter

As an electrical drive controller, a key feature of a frequency inverter is that changes can be made to process variables (e.g., speed, position, and torque) using analog or digital signals. Additional information is required to optimize the adaptation of the drive controller and motor to the process. As well as setpoint information, the frequency inverter also requires information about the motor type point, the minimum and maximum permissible speed of the system, the maximum speed variation during acceleration and deceleration, starting ramp, starting current, etc.

These types of additional information are device-specific parameters, which can be modified via the parameter data channel.

The parameter values for all PCP devices are the subject of communication via the parameter data channel. To enable the individual parameters to be distinguished during communication, each parameter has a number, the index.

Index

The index is the address of the communication object. It is required to identify the object.

Acyclic Communication (DP/V1 and PCP)

Table 4-1 Object Description (example)

Object Description (OD)			
Index	Type	Object	Name
...	...	...	...
60 4A _{hex}	Ramp	Record	Speed quick stop
60 4B _{hex}	Integer16	Array	SetpointFactor
...	...	...	...

Object Description

The object description includes all the properties of the object, such as data type, object type, name, etc.

Object types

There are various different object types:

Simple variable

- Simple variable type objects.
Examples include measured values, the time or status of a device.

Array

- Array type objects, i.e., several "simple variable" objects of the same type, which are grouped to form one object. Each element can be accessed individually.
An example of an array is a range of the same type of measured values.

Record

- Record type objects, i.e., several "simple variable" objects of different types, which are grouped to form one object. As for the array type, each element of a record can be accessed individually. An example of a record is the group of data in a test report, which contains not only the actual measured value, but also additional information, e.g., the time of the measurement.

Program invocation

- Program invocation type objects, i.e., program sequences that can be run.



For additional information on PCP communication, please refer to the IBS SYS PCP G4 UM E user manual, Order No. 27 45 16 9.

4.4 Acyclic Communication in DP/V1 Mode

4.4.1 The Communication Mechanism

Data access types: accesses onto local bus device data or onto FLM BK PB M12 DI 8 M12 bus coupler data:

Table 4-2 Objects on the FLM BK PB M12 DI 8 M12 bus coupler

Data Type	Accessing I/O Devices	Access to FLM BK PB M12 DI 8 M12 Device	Slot	Index/dec
PDU Length	–	x	0	3
Master Control	–	x	0	4
PCP Status	–	x	0	5
Enabling a Device	–	x	0	6
Enabling a Device / Restart	–	x	0	7
Device diagnostics	–	x	0	12
Cycle Count	–	x	0	20
Cycle Error Count	–	x	0	21
ID Cycle Count	–	x	0	22
ID Cycle Error Count	–	x	0	23
Data Cycle Count	–	x	0	24
Data Cycle Error Count	–	x	0	25
I & M 0	–	x	0	255
PD-IN	–	x	1 to 63	13
PCP access	x	–	2 to 63	47

During the access onto the FLM BK PB M12 DI 8 M12 bus coupler use the well established DP/V1 format. Read and write accesses can be executed in one step (request -> response).

The PCP data from I/O devices is usually addressed via 16-bit object indices. DP/V1 only has fields for 8-bit indices. Additional parameters have therefore been added to the data block for use when accessing the local bus, as for PROFIDrive. A sequence involving 2 steps is used, which follows the PROFIDrive profile:

Read:

1. a) Send the request as DP/V1 Write Request (PCP Read) to slot x
b) Receiving the DP/V1 Write Response - often automatically via the master
2. a) Sending a DP/V1 Read to slot x
b) Receiving the DP/V1 Read Response - often automatically via the master

Write:

1. a) Send the request as DP/V1 Write Request (PCP Write) to slot x
b) Receiving the DP/V1 Write Response - often automatically via the master
2. a) Sending a DP/V1 Read to slot x
b) Receiving the DP/V1 Read Response - often automatically via the master

Acyclic Communication (DP/V1 and PCP)

Note that when communicating with objects on local bus devices, the response should be fetched using Read. Otherwise the result will be overwritten during the next communication. Communication is always carried out via DP/V1 index 47, and the object index and assigned subindex of the I/O device are transmitted as part of the data field.

Request and Response

The section below provides additional information about the format of write and read accesses (Request and Response).

The format for all types of access (Request and Response (positive), Read and Write) in DP/V1 is:

<DP/V1 header> <Data (PCP/DP/V1)>

The DP/V1 header for a positive DP/V1 response always has the following format:

<DP/V1 service (positive)> <Slot> <DP/V1 index> <DP/V1 length>

In the event of a faulty response, the format is as follows:

– For a DP/V1 error:

<DP/V1 service (negative)> <Error decode> <Error code 1> <Error code 2>

– For an I/O device error:

<DP/V1 service (positive)> <Slot> <DP/V1 index> <DP/V1 length> <Error data (PCP / DP/V1)>

The <Data (PCP/DP/V1)> is optional depending on the service and has the following structure:

Table 4-3 Structure of the data depending on the service

Access	Service	Data
Write objects (FLM BK PB M12 DI 8 M12)	DP/V1 Write Request	Object data
	DP/V1 Write Response	None
Read objects (FLM BK PB M12 DI 8 M12)	DP/V1 Read Request	None
	DP/V1 Read Response	Object data
Write objects (I/O device)	DP/V1 Write Request (PCP Write)	Write PCP Request / Invoke ID / Index High / Index Low / Sub-index / Length PCP Data / x Byte PCP Object Data
	DP/V1 Write Response	None
	DP/V1 Read Request	None
	DP/V1 Read Response	Write PCP Ack / Invoke ID / Status
Read objects (I/O device)	DP/V1 Write Request (PCP Read)	Read PCP Req / Invoke ID / Index High / Index Low / Subindex
	DP/V1 Write Response	None
	DP/V1 Read Request	None
	DP/V1 Read Response	Read PCP Ack / Invoke ID / Status / Length of PCP data/x bytes of PCP object data

The meanings of the individual parameters are as follows:

– <DP/V1 service>:

In the request there is a distinction between DP/V1 Read (5E_{hex}) and DP/V1 Write (5F_{hex}); in the error response there is a distinction between DE_{hex} (Read error) and DF_{hex} (Write error).

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- <Slot>:
The slot of the device to be addressed in the station. The bus coupler is addressed with slot =0, the integrated DI 8 is addressed with slot =1 and starting with the first connected device with slot 2 up to 63.
- <DP/V1 index>:
During accesses onto the PCP objects, the local bus device is to be used as PROFIBUS index 47_{dec} (= 2F_{hex}). The PCP index is transmitted as part of the data field. During accesses onto the bus coupler, the object index can be used directly.
- <DP/V1 length>:
On a write access, the length of the subsequent data is entered here, and on a read access, the length of the expected data is entered. On a response, this parameter contains the actual length of the DP/V1 data.
- <Error decode>:
80_{hex} indicates an error in DP/V1.
- <Error code 1> and <Error code 2>:
Contain the error codes from the DP/V1 access (see "Error Codes for DP/V1 and VC1 Communication" on page A-3).
- <Write PCP/Read PCP>:
This indicates whether the following object index should be written or read. Read PCP = 06_{hex}; Write PCP = 07_{hex}.
- <Object data>
This is only the contents of an object. The length and scope of the data has already been described by <DP/V1 length>.
- <Invoke ID>
The Invoke ID is used for some I/O devices. Check it in the respective data sheet at hand.
- <Index high and Index low>
This specifies the object index of the addressed PCP object in two bytes. For example, for index 2300_{hex} the value 23_{hex} should be entered for Index high and the value 00_{hex} should be entered for Index low.
- <Subindex>
When working with a PCP object, the subindex can be used to select a specific element from an array or record.
- <Length of PCP data>
This value specifies how many bytes of PCP object data (object contents) follow.
- <PCP object data>
This is the actual contents of a PCP object.
- <Status>
For a positive PCP response, the status is = 00_{hex}, in the event of an error it is 44_{hex}.
- -<Error data (PCP/DP/V1)>:
the structure of the error data is <PCP confirmation code> <Invoke ID>
<Status = 44_{hex}> <PCP error code (4 bytes)>.
(PCP error code, see "Error Codes for DP/V1 and VC1 Communication" on page A-3).



During the access onto PCP, please note the first byte in the DP/V1 data block. With 06_{hex}, PCP Read and with 07_{hex} a PCP Write is executed.

Acyclic Communication (DP/V1 and PCP)

4.4.2 Examples

The section below provides a few examples to aid understanding (all values in hex). These examples indicate how objects on the bus coupler and the I/O devices can be read and written.

The station structure is as follows:

- FLM BK PB M12 DI 8 M12
- FLM DIO 4/4 M12-2A
- FLM AI 4 SF M12
- FLM AO 4 SF M12
- PD/PCP x words

The FLM AI 4 SF M12 and the FLM AO 4 SF M12 are PCP-capable devices.

For a better understanding of the examples, the object directory of the FLM AI4 SF M12 device should be given:

The FLM AI 4 SF M12 object directory contains - among others - the following object:

Table 4-4 Object Directory of the FLM AI 4 SF M12

Index	Data Type	A	L	Meaning	Object Name	Rights
0080 _{hex}	Array of Unsigned 16	6	2		Config Table	rd/wr

A: Number of elements rd: Read access permitted

L: Element length in bytes wr: Write access permitted

Table 4-5 Object Description:

Object	Config Table	
Access	Read, write	
Data type	Array of Unsigned 16 6 x 2 bytes	
Index	0080 _{hex}	
Subindex	00 _{hex}	Write all elements
	01 _{hex}	Configuration channel 1
	02 _{hex}	Configuration channel 2
	03 _{hex}	Configuration channel 3
	04 _{hex}	Configuration channel 4
	05 _{hex}	Reserved
	06 _{hex}	Reserved
Length (byte)	0C _{hex}	Subindex 00 _{hex}
	02 _{hex}	Subindex 01 _{hex} to 06 _{hex}
Data	Device configuration	

Objects 4 and 4 on the bus coupler are also used in these examples. For an explanation regarding these objects, please refer to section "Object Dictionary" on page 3-27.

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Example 1:

Reading the connected local PCP devices and their status (Slot 0, Index 5 on the bus coupler)

Read request (master -> slave)

Data	Data Structure
5E 00 05 20	DP/V1 Read / Slot / Index / Maximum Length

Read request (slave -> master)

Data	Data Structure
5E 00 05 06 03 01 00 04 01 00	DP/V1 Read / Slot / Index / Actual Length 6 bytes object data

The data shows that there is one PCP device each on slot 3 and 4, and its connection status is OK, see section "Object Dictionary" on page 3-27.

Example 2:

Writing the bus restart bit (slot 0, index 4, bit 0 on the bus coupler)

Write request (master -> slave)

Data	Data Structure
5F 00 04 01 01	DP/V1 Write / Slot / Index / Length / 1 byte of data

Write response (slave -> master)

Data	Data Structure
5F 00 04 01	DP/V1 Write / Slot / Index / Length

The data block is only important in the request. The response indicates that the command has been received. As can be seen in "Object Dictionary" on page 3-27, the local bus is restarted using bit 0 (01_{hex}) at index 4, slot 0.

Acyclic Communication (DP/V1 and PCP)

3. Example:

Reading the Config Table on the connected FLM AI 4 SF (slot 3, index 0080)

Write request (master -> slave)

Data	Data Structure
5F 03 2F 05 06 00 00 80 00	DP/V1 Write / Slot / Index / Length / Read PCP Request / Invoke ID / PCP Index high / PCP Index low / PCP Subindex

Write response (slave -> master)

Data	Data Structure
5F 03 2F 05	DP/V1 Write / Slot / Index / Length

Read request (master -> slave)

Data	Data Structure
5E 03 2F 20	DP/V1 Read / Slot / Index / Maximum Length

Read response (slave -> master)

Data	Data Structure
5E 03 2F 10 86 00 00 0C 03 01 03 00 03 01 03 00 00 00 00 00	DP/V1 Read / Slot / Index / Actual Length PCP Read Response / Invoke ID / Status / Length of PCP data/ 12 bytes of PCP object data

In the Read Response, the user will receive the 12 bytes of object 80_{hex} on the FLM AI 4 SF as described above. The settings on channel 1 and 3 are identical as well as of channel 2 and 4. Bytes 9 and 12 are reserved and are indicated as 0. The Invoke ID had been mirrored and the status indicates that the communication was error-free.

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4. Example:

Writing the Config Table for channel 3 on the connected FLM AI 4 SF (Slot 3, Index 0080, Subindex 3)

Write request (master -> slave)

Data	Data Structure
5F 03 2F 08 07 00 00 80 03 02 03 01	DP/V1 Write / Slot / Index / Length / Write PCP Request / Invoke ID / PCP Index high / PCP Index low / PCP Subindex / Length of the PCP object data / PCP object data

Write response (slave -> master)

Data	Data Structure
5F 03 2F 08	DP/V1 Write / Slot / Index / Length

Read request (master -> slave)

Data	Data Structure
5E 03 2F 20	DP/V1 Read / Slot / Index / Maximum Length

Read response (slave -> master)

Data	Data Structure
5E 03 2F 03 87 00 00	DP/V1 Read / Slot / Index / Actual Length Write PCP Response / Invoke ID / Status

In the Read Response, the mirrored Invoke ID is the result and the status is 00.

Acyclic Communication (DP/V1 and PCP)

5. Example:

In the event of an error: reading faulty object indices on the connected FLM AI 4SF (Slot 3, Index 0180)

Write request (master -> slave)

Data	Data Structure
5F 03 2F 05 06 00 01 80 00	DP/V1 Write / Slot / Index / Length / Read PCP Request / Invoke ID / PCP Index high / PCP Index low / PCP Subindex

Write response (slave -> master)

Data	Data Structure
5F 03 2F 05	DP/V1 Write / Slot / Index / Length

Read request (master -> slave)

Data	Data Structure
5E 03 2F 20	DP/V1 Read / Slot / Index / Maximum Length

Read response (slave -> master)

Data	Data Structure
5E 03 2F 07 86 00 44 06 07 00 00	DP/V1 Read / Slot / Index / Actual Length PCP Read Response / Invoke ID / Status / Error Data PCP

The status byte 44_{hex} characterizes an error during execution. In this case, the PCP Read Request is transmitted to the I/O device first. However, the I/O device does not know this index and acknowledges it using the error code 06 07. In accordance with the section "Error Codes for PCP Communication" on page A-1, this means that the object does not exist. The last 2 bytes are also part of the PCP error data, however, they are not used in this example. If it does not equal zero, the respective data I/O device data sheet contains more detailed information.

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6. Example:

In the Event of an Error: Reading an object on a device without PCP (Slot 2, Index 0080)

Write request (master -> slave)

Data	Data Structure
5F 02 2F 05 06 00 00 80 00	DP/V1 Write / Slot / Index / Length / Read PCP Request / Invoke ID / PCP Index high / PCP Index low / PCP Subindex

Write response (slave -> master)

Data	Data Structure
DF 80 D2 00	DP/V1 Write Error / Error Decode / Error Code1 / Error Code 2

Since the addressed device does not support PCP, the request is rejected immediately. A message from the DP/V1 occurs, in this case, the error code D2 stands for "device does not have PCP". See also section "Error Codes for DP/V1 and VC1 Communication" on page A-3.

4.5 Acyclic Communication in DP/V0 Mode via Process Data

The DP/V1 communication is relatively new compared to cyclic DP/V0 communication. However, the life of control systems and plants is so long that expansions and modifications are made. In many cases, the control system is not DP/V1-compatible, but is expected to operate complex devices.

Acyclic services

For this purpose, the operation of the acyclic services is also possible within the process data, i.e., also control systems that does not have DP/V1 can operate more complex devices.

Additional information on PCP communication can be found in sections "PCP Communication Basics" on page 4-3 and "Acyclic Communication (DP/V1 and PCP)" on page 4-1.

4.5.1 Mechanism for Transmission in the Process Data

VC1 device

Transmission is via a virtual C1 device (VC1 device). A C1 device should be selected in the hardware configurator in the same way as "normal" I/O devices and therefore specified in the configuration and parameter telegram.

The VC1 device is only a virtual device because the process data can be used to transmit communication data (PCP) and is not linked to a specific device. During active process data exchange, it is possible to assign the VC1 device sequentially to different devices with communication objects and to exchange parameter data parallel to the process data.

Process data width

The process data width occupied by the VC1 devices in the process data channel can be selected from 4 to 16 words in increments of 2 words. This means that communication objects can be used even if resources are scarce. If there are sufficient free resources, a data width of up to 16 words can be used, providing the same ease of operation as for DP/V1 communication.

As the data width of the VC1 devices is between 4 and 16 words, but the user data can be up to 72 bytes (36 words) per communication, it may be necessary to split the data and transmit it in several steps.

This leads to:

- **Start fragment**
- **Continue fragment**
- **End fragment**
- **Error or abort fragment**

Each fragment contains a service byte, which is used for the precise assignment of the fragment. The individual fragments and the service byte are explained in detail in the following.



The VC1 device (listed as "PD PCP x words" in the GDS file) can be configured at any position behind the FLM BK PB M12 DI 8 M12 bus coupler. We recommend to configure the VC1 device at the last position. In this way, the configured slot and the actual slot occupied by the I/O device will always be identical. It is not linked to any hardware, so a device is not actually inserted.

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Start Fragment:

- Byte 1:** Service
- Byte 2:** Device no.
- Byte 3:** Invoke ID
- Byte 4:** Index high
- Byte 5:** Index low
- Byte 6:** Subindex
- Byte 7:** Length, if required
- Byte 8:** Data block, if required
- ...
- Byte n:** Data block, if required

Table 4-6 Byte 1 - Service in start fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ response	0	0	Fragmentation	Action			

Bit 7: Request/response

- 0 = Request
- 1 = Response

Bits 6 to 5: Fragment type

- 00 = start fragment

Bit 4: Fragmentation

- 0 = Not fragmented
- 1 = fragmented

Bits 3 to 0: Action

- 00_{hex} No action (clear)
- 01_{hex} up to 02_{hex} Reserved
- 03_{hex} Read (FLM BK PB M12 DI 8 M12)
- 04_{hex} Write (FLM BK PB M12 DI 8 M12)
- 05_{hex} Reserved
- 06_{hex} Read PCP (I/O terminal)
- 07_{hex} Write PCP (I/O terminal)
- 08_{hex} Read and Write simultaneously (special objects only)
- 09_{hex} to 0F_{hex} Reserved

Acyclic Communication (DP/V1 and PCP)

Continue Fragment:

- Byte 1:** Service
Byte 2: Data block, if required
 ...
Byte n: Data block, if required

Table 4-7 Byte 1 - Service in continue fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ response	0	1	Fragment number (01 _{hex} - 1F _{hex})				

Bit 7: Request/response

- 0 = Request
 1 = Response

Bits 6 to 5: Fragment type

- 01 = Continue fragment

Bits 4 to 0: Numerator

- 01_{hex} up to 1F_{hex} fragment no.

End Fragment:

- Byte 1:** Service
Byte 2: Data block, if required
 ...
Byte n: Data block, if required

Table 4-8 Byte 1 - Service in end fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ response	1	0	Reserved				

Bit 7: Request/Response

- 0 = Request
 1 = Response

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- Bit 7:** Request/Response
- Bits 6 to 5:** Fragment type
 - 10 = Last fragment (end fragment)
- Bits 4 to 0:** Reserved

Acyclic Communication (DP/V1 and PCP)

Abort/Error Fragment:

Byte 1: Service
Byte 2: Error code, if required
 ...
Byte n: Error code, if required

Table 4-9 Byte 1 - Service in abort/error fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ response	1	1	Reserved				

Bit 7: Request/response

0 = Request

1 = Response

Bits 6 to 5: Fragment type

11 = Abort/error fragment

Bits 4 to 0: Reserved



The communication can reset anytime using 00_{hex} and 60_{hex}.

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A response is sent after every request. This response indicates that the request has been received and shows its current status:

Response Structure:

Byte 1: Service (mirrored request with set response bit)

Byte 2: Status, if required

Byte 3: Length, only on first read response

...

Byte n: Data block, if required

The status is indicated when local PCP transmission is complete and in the event of an error. In the event of an error, the data block can provide details. An error has occurred if the value of the status byte does not equal 00_{hex}.

00 _{hex}	No error
44 _{hex}	Error during communication
Other errors	see "Error Codes for DP/V1 and VC1 Communication" on page A-3.

For VC1, the parameters have the following meaning:

- <Device no.>

The FLM BK PB M12 DI 8 M12 bus coupler counts the device as 0, the integrated DI 8 as 1 and starting with the first connected node as device = 2...63.

- <Invoke ID>

The Invoke ID has a length of one byte and is used for some I/O devices only. Test it in the respective data sheet at hand.

- <Index high and Index low>

This specifies the object index of the addressed object in two bytes. This is also valid for objects on the FLM BK PB M12 DI 8 M12 bus coupler, e.g., for index 5FE0_{hex} the value 5F_{hex} should be entered for Index high and the value E0_{hex} should be entered for Index low. For index 4_{hex} on the bus coupler, 00_{hex} is Index high and 04_{hex} is Index low.

- <Subindex>

When working with a PCP object, the subindex can be used to select a specific element from an array or record. Thus the subindex is to be indicated during accesses onto I/O devices. The bus coupler has no arrays or records, so subindex 0 should be entered.

- <Length>

This value specifies how many bytes of object data (object contents) follow. Depending on the slot, this may be bus coupler object data or I/O device object data.

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- <Data block>

This is only the contents of an object. The length and scope of the data has already been described by the <Length> parameter.

To aid understanding, the same examples are used in the following section as for DP/V1 services. This means that the description of the examples for DP/V1 communication is valid again here, see Section "Examples" on page 4-9. See also "Error Codes for DP/V1 and VC1 Communication" on page A-3.

4.5.2 Examples of VC1 Services

1. Example:

**Reading the connected local PCP devices and their status
(slot 0, index 5 on the bus coupler)**

Read request (master -> slave)

Data (8 Words VC1)	Data Structure
03 00 00 00 05 00 01 00 00 00 00 00 00 00 00 00 00	Read Request (bus coupler) / Slot / Invoke ID / Index high / Index low / Subindex / 10 Byte unused

Read response (slave -> master)

Data (8 Words VC1)	Data Structure
83 00 06 03 01 00 04 01 00 01 00 00 00 00 00 00 00	Read response (bus coupler) / Status / Actual length / 6 bytes of object data / 7 bytes unused

Clear request (master -> slave)

Data (8 Words VC1)	Data Structure
00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Clear Request / 15 bytes unused

Clear response (slave -> master)

Data (8 Words VC1)	Data Structure
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Clear response

The status byte equals zero. This means that the communication was correct. The data shows that there is one PCP device each on slot 3 and 4, and its connection status is OK, see section "Object Dictionary" on page 3-27.

Via Clear, the communication data can be reset to the initial state.

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2. Example:

Writing the bus restart bit (slot 0, index 4, bit 0 on the bus coupler)

Write request (master -> slave) - start fragment

Data (6 Words VC1)	Data structure
04 00 00 00 04 00 01 01 00 00 00 00	Write Request (bus coupler) / Slot / Invoke ID / Index high / Index low / Subindex / Length / 1 data byte / 4 bytes unused

Write response (slave -> master)

Data (6 Words VC1)	Data Structure
84 00 00 00 00 00 00 00 00 00 00 00 00	Write Response (bus coupler) / Status / 10 bytes unused

Clear request (master -> slave)

Data (6 Words VC1)	Data Structure
00 00 00 00 00 00 00 00 00 00 00 00	Clear Request / 11 bytes unused

Clear response (slave -> master)

Data (6 Words VC1)	Data Structure
00 00 00 00 00 00 00 00 00 00 00 00	Clear response

The response indicates that the command has been received. Here, the status is positive (=0) Via Clear, the communication data can be reset to the initial state.

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3. Example:

Reading the Config Table on the connected FLM AI 4 SF (slot 3, index 0080)

Read request (master -> slave) - start fragment

Data (4 Words VC1)	Data Structure
06 03 00 00 80 00 00 00	Read Request (I/O) / Slot / Invoke ID / Index high / Index low / Subindex / 2 Byte unused

Read response (slave -> master)

Data (4 Words VC1)	Data Structure
96 00 0C 03 01 03 00 03	Read Response / Status / Length / 5 bytes object data

Read request (master -> slave) - acknowledgment of start fragment

Data (4 Words VC1)	Data Structure
96 00 00 00 00 00 00 00	Acknowledgement start fragment / 7 bytes un- used

Read response (slave -> master)

Data (4 Words VC1)	Data Structure
C0 01 03 00 00 00 00 00	Termination fragment / 7 object data bytes

In the Read Response, the user will receive the 12 bytes of object 80_{hex} on the FLM AI 4 SF as described above. The first 5 object data bytes are transmitted in the start fragment. The missing 7 bytes follow in the second fragment which is already the last. The status byte indicates that the communication was correct.

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For the bus coupler the service is finished as soon as the last fragment has been transmitted. If the next service byte differs from the previous, the process can be started right with the next Read/Write. Alternatively, the last fragment can either be acknowledged or a Clear can be sent.

Acknowledgement of the last fragment:

Read request (master -> slave) - acknowledgment of end fragment

Data (4 Words VC1)	Data Structure
C0 I 00 00 00 00 00 00 00	Acknowledgement end fragment / 7 bytes unused

Read response (slave -> master)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear

Or

Clear:

Clear request (master -> slave)

Data (4 Words VC1)	Data Structure
00 I 00 00 00 00 00 00 00	Clear Request / 7 bytes unused

Clear Response (slave -> master)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear Response

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4. Example:

Writing the Config Table for channel 3 on the connected FLM AI 4 SF (slot 3, index 0080, subindex 3)

Write request (master -> slave) - start fragment

Data (4 Words VC1)	Data Structure
17 03 00 00 80 00 0C 03	Write Request (I/O) / Slot / Invoke ID / PCP Index high / PCP Index low / PCP Subindex / Length of the PCP object data / 1 byte PCP object data

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
17 1 00 00 00 00 00 00	Write Response / 7 bytes unused

Write request (master -> slave) - 1st continue fragment

Data (4 Words VC1)	Data Structure
21 00 03 01 03 00 03 01	1. Continue fragment / 7 bytes PCP object data

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
21 1 00 00 00 00 00 00	Response / 7 bytes unused

Write request (master -> slave) - end fragment

Data (4 Words VC1)	Data Structure
40 00 00 00 00 1 00 00 00	End fragment / 4 bytes PCP object data / 3 Byte unused

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
87 00 1 00 00 00 00 00	Response / Status / 6 bytes unused

Clear request (master -> slave)

Data (4 Words VC1)	Data Structure
00 1 00 00 00 00 00 00	Clear Request / 7 bytes unused

Clear Response (slave -> master)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear Response

Here, the Write specification is given in 3 fragments. Only after the reception of the last fragments, the bus coupler takes over the request. The response "87" shows that the "07" command was executed. The status "0" shows that the transmission was successful.

Via Clear, the communication data can be reset to the initial state.

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5. Example:

In the event of an error:

Reading faulty object indices on the connected FLM AI 4SF (slot 3, index 0180)

Read request (master -> slave) - start fragment

Data (4 Words VC1)	Data Structure
06 03 00 01 80 00 I 00 00	Read Request (I/O) / Slot / Invoke ID / Index high / Index low / Subindex / 2 bytes unused

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
86 44 06 07 00 00 I 00 00	Read Response / Status / 4 bytes error code / 2 bytes unused

Clear request (master -> slave)

Data (4 Words VC1)	Data Structure
00 I 00 00 00 00 00 00	Clear Request / 7 bytes unused

Clear Response (slave -> master)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear response

The status byte 44_{hex} characterizes an error during execution. In this case, the PCP Read Request is transmitted to the I/O device first. However, the I/O device does not know the index 0180_{hex} and acknowledges it using the error code 06 07. In accordance with the section "Appendix" on page A-1, this means that the object does not exist. The last 2 bytes are also part of the PCP error data, however, they are not used in this example. If it does not equal zero, the respective data I/O device data sheet contains more detailed information.

Via Clear, the communication data can be reset to the initial state.

Acyclic Communication (DP/V1 and PCP)

6. Example:

**In the event of an error: reading an object on a device without PCP
(Slot 2, Index 0080)**

Read request (master -> slave)

Data (4 Words VC1)	Data Structure
06 02 00 00 80 00 00 00	Read Request / Slot / Invoke ID / Index High / Index Low / Subindex / 2 bytes unused

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
86 D2 00 00 00 00 00 00	Read Response / Status / 6 bytes unused

Clear request (master -> slave)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear Request / 7 bytes unused

Clear Response (slave -> master)

Data (4 Words VC1)	Data Structure
00 00 00 00 00 00 00 00	Clear Response

Since the addressed device does not support PCP, the request is rejected immediately. A message from the bus coupler - managing the PCP devices - occurs. In this case, the error code D2 stands for "device does not have PCP". See also "Error Codes for DP/V1 and VC1 Communication" on page A-3. Via Clear, the communication data can be reset to the initial state.

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5 Dynamic Configuration

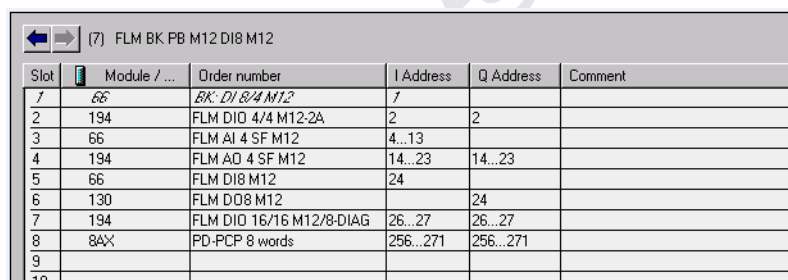
Dynamic configuration is the specification and configuration of a maximum configuration. Any subgroup of this maximum configuration can be operated.

In addition to dynamic configuration, empty spaces can be reserved for future expansions.

5.1 Empty Spaces

It can be helpful to reserve empty spaces for a station, which may be used at different configuration levels. You can configure the maximum configuration level and thus also reserve memory in the PLC. However, optional devices must not be connected. They can be deactivated in the configuration.

If the station is subsequently expanded to include previously deactivated devices, the new devices can be connected and activated in the hardware configurator.



Slot	Module / ...	Order number	I Address	Q Address	Comment
1	66	BK: DI 8/4 M12	1		
2	194	FLM DIO 4/4 M12-2A	2	2	
3	66	FLM AI 4 SF M12	4...13		
4	194	FLM AO 4 SF M12	14...23	14...23	
5	66	FLM DI8 M12	24		
6	130	FLM DO8 M12		24	
7	194	FLM DIO 16/16 M12/8-DIAG	26...27	26...27	
8	84X	PD-PCP 8 words	256...271	256...271	
9					
10					

Figure 5-1 Configuration table in the STEP 7[®] hardware configurator

The configuration, e.g., in STEP 7[®], is carried out in the same way as for other modular slaves. The configuration can be created from the hardware catalog using drag & drop, see Figure 5-1.

Open the "Properties" dialog box by double-clicking on a device.

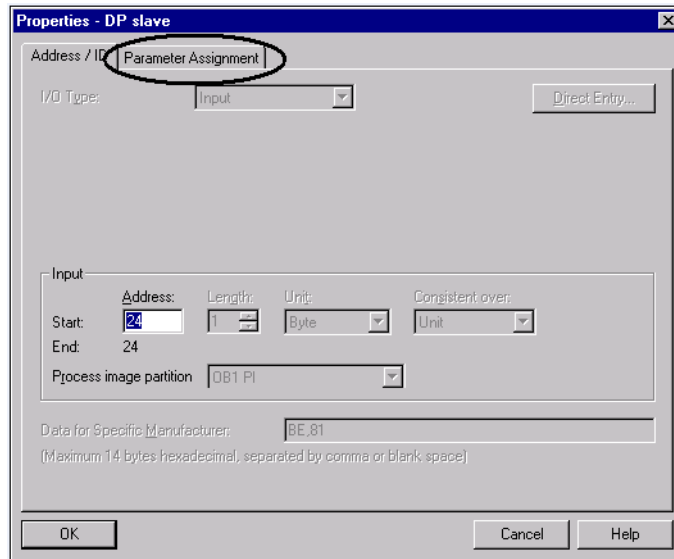


Figure 5-2 DI 8 features dialog

The "Parameter Assignment" tab can be used to specify whether a device should be active or inactive, see Figure 5-3.



Please note that adjustments to the configuration and actual structure are also carried out for inactive devices. A message is displayed if deactivated devices are connected.

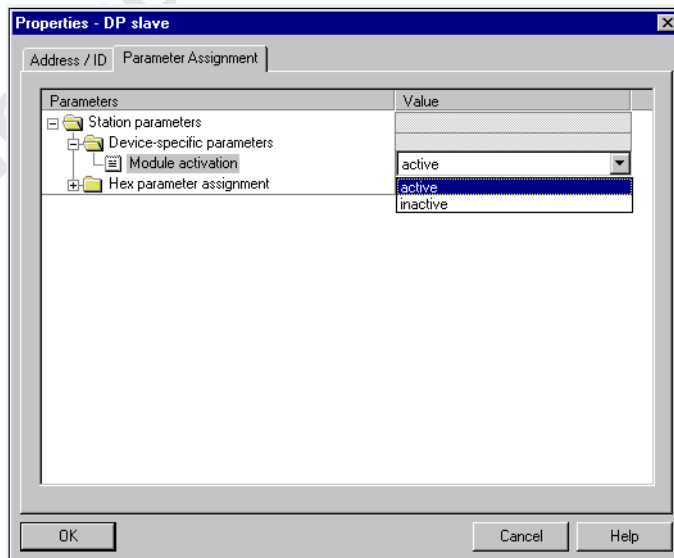


Figure 5-3 Activating/deactivating a device

Dynamic Configuration

Following activation/deactivation, the configuration can be saved, translated, and downloaded as usual.

Depending on the device type, substitute values (DO and AO) to be output in the event of an error can also be set at this point, for example. Furthermore, inputs (AI) can be parameterized. This is also carried out via the dialog box shown in Figure 5-3.

5.2 Principle of the Dynamic Configuration

In dynamic configuration, a maximum configuration is specified during configuration. The addresses are thus reserved in the PLC. Any subgroup of this maximum configuration can be operated. Such a group can be selected and activated during configuration and during run-time. The advantage is that the application can divide an identical hardware configuration into active and inactive devices.

Optional devices that are only required for additional functions need not to be connected. They can simply be deactivated by the application.

If an extension is to be realized later-on, the application can activate the new devices. Pre-requisite is only that they are part of the maximum configuration.

All settings are stored in the volatile memory. Thus easy replacement is ensured. The device must not be parameterized in advance.

Three indices on the bus coupler are used for the handling:

Index 4: General control bits

Access: Write

Function: Details under "Slot 0" on page 3-27 Please observe bit 0 and bit 3 during dynamic configuration.

Structure: Length of 1 byte

Bit 0: Restart local bus

Bit 3: Unlock dynamic configuration

Index 6: Activation / deactivation of devices and slots

Access: Read and Write

Function: Indicates which devices are active / inactive. Deactivation via the parameter telegram (reservation of empty spaces) is also indicated here.

Structure: Length of 8 bytes

Byte 1								Byte 2								Bytes 3 to 7	Byte 8							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	...	57	58	59	60	61	62	63	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

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Index 7: Activation / deactivation of devices and slots and bus reset

Access: Only via DP/V0, command 8

Function: Indicates which devices are active / inactive. Deactivation via the parameter telegram (reservation of empty spaces) is also indicated here. In addition, a bus reset takes place.

Structure: Length: 5 up to a maximum of 12 bytes

Byte 1: 08_{hex}

Byte 2: 00_{hex}

Byte 3: 07_{hex}

Byte 4: Length of data n

Byte 5: 1 2 3 4 5 6 7 8

...

Byte 4+n: x x x x x x x x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

5.3 Startup

5.3.1 Planning Configuration

Figure 5-4 shows an example of the maximum configuration, as provided. All devices are activated by default.

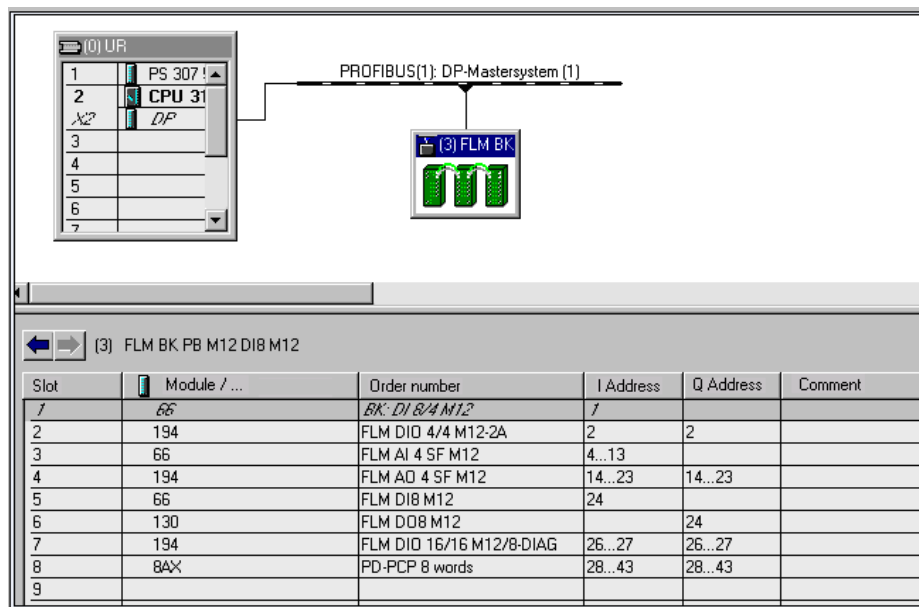


Figure 5-4 Configuration in the STEP 7[®] hardware configurator

The accesses onto the indices 4 and 6 described in the introduction can either be realized via PROFIBUS DP/V1 or via the process data interface. Index 7 is intended to be used if no DP/V1 master exists or if the specification as well as the bus restart are to be realized using one single service in the process data interface only. If the process data interface is used, the effort is minimized.

For the access via process data, please configure the so-called VC1 process data interface. This is the "PD PCP x Words" (x = 4, 6, ..., 16) module. You can specify it as first or as last module in the station and you can select the data width and address in accordance with the options in the CPU.

The residual devices can be configured as usual.

5.3.2 Options for Specifying the Active Configuration

In the following example, the 8-channel digital devices are not part of the station, i.e., these devices are part of the maximum configuration, but are to be deactivated at this station.

There are two options for startup:

- 1** Deactivating devices in the hardware configuration per default
 - This option can easily be realized. Having set the "Module activation" parameters to "inactive", the configuration can be downloaded to the controller as usual, see "Activating/deactivating a device" on page 5-2.
- 2** Via DP/V1 or DP/V0 with maximum configuration and final specification in the application
 - Specify the maximum configuration in the hardware configuration and download it.
 - Go to cyclic data exchange.
 - On the I/O devices, no data are exchanged as long as the connected configuration is not identical with the accessible, activated devices.
 - Specify the configuration connected to the station in a non-volatile memory via Index 6 or Index 7.
 - Data exchange is started

For the second option, the example from Figure page 5-5 is used and the DI 8 as well as the DO 8 is activated via DP/V0 and DP/V1. In each case, the data are to be written is indicated. For further information on the protocol, please refer to section "Acyclic Communication in DP/V1 Mode" on page 4-6 and section "Acyclic Communication in DP/V0 Mode via Process Data" on page 4-15. Here, you will find further examples on communication via DP/V0 and DP/V1. The individual indices are explained in section "Slot 0" on page 3-27.

Which option will be used in the end, depends on the support of DP/V1 in the master. If the DP/V1 is not (well) supported, DP/V0 should be used. For SIMATIC® STEP 7® CPU functions are available that have been prepared by Phoenix Contact.

Dynamic Configuration

5.3.3 Specification of the Active Configuration via DP/V0

For DP/V0, you can access the activation status via Index 6 or 7. There are different object structures. Thus example accesses are illustrated for both objects.

Access via Index 6

Please observe the structure of Index 6 when accessing it:

Byte 1								Byte 2								Bytes 3 to 7	Byte 8							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	...	57	58	59	60	61	62	63	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

In this example there are 7 connected devices. The devices 1, 2, 3, 4, and 7 must be active. The devices 5 and 6 are inactive.

The resulting data for object 6 are the following:

F2_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}

In the following, the description of these 8 data bytes serves as example for two optional data widths of the VC1 device.



If a new activation status is described via Index 6 or Index 7, it becomes only valid as soon as the bus is restarted.

2 corresponding examples:

If - as described in this example - the configuration and the accessible devices are not identical, because e.g. 2 devices are not connected, the bus is read in continuously until it is identical with the configuration. In the course of this, the activation status on Index 6 is evaluated automatically.

If the dynamic bus structure is expanded and if previously inactive devices are attached to the end, these devices are activated via Index 6 at first. During the next bus start, the new devices are integrated into data traffic. The bus can be started via Index 4, bit 0. Please note that during reset the device output data are reset to their device-specific reset values.

If the continuous bus structure is expanded and previously inactive devices are attached to the end, device activation and bus restart can simultaneously be realized via Index 7. In the course of this, the new devices are integrated into data traffic. Please note that during reset the device output data are reset to their device-specific reset values.

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4 Words VC1

Write request (master -> slave) - start fragment

Data (4 Words VC1)	Data Structure
14 00 00 00 06 00 08 F2	Write / Slot / Invoke ID / Index High / Index Low / Subindex / Length / 1 byte data

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
14 I 00 00 00 00 00 00 00	Write Response / 7 bytes unused

Write request (master -> slave) - end fragment

Data (4 Words VC1)	Data Structure
40 00 00 00 00 00 00 00	Write/7 bytes of data

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
84 I 00 00 00 00 00 00 00	Write Response / Status / 6 bytes unused

8 Words VC1

Write request (master -> slave) - start fragment

Data (8 Words VC1)	Data Structure
14 00 00 00 06 00 08 F2 00 00 00 00 00 00 00 I 00	Write / Slot / Invoke ID / Index High / Index Low / Subindex / Length/ 8 byte data / 1 byte unused

Write response (slave -> master)

Data (8 Words VC1)	Data Structure
14 I 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Write Response / 15 bytes unused

Dynamic Configuration

Access via Index 7

Please observe the structure of Index 7 when accessing it:

```

Byte 1    08hex
Byte 2    00hex
Byte 3    07hex
Byte 4    Length of data n
Byte 5    1  2  3  4  5  6  7  8
...
Byte 4+n  x  x  x  x  x  x  x  x

```

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

In this example there are 7 connected devices. The devices 1, 2, 3, 4, and 7 must be active. The devices 5 and 6 are inactive.

The resulting data for object 7 are the following:

08_{hex}, 00_{hex}, 07_{hex}, 01_{hex}, F2_{hex}

The fourth byte for Index 7 contains the length. Thus only as many bytes as devices to be de-/activated need to be transmitted.

These 5 data bytes are described in the following:

4 Words VC1

Write request (master -> slave) - start fragment

Data (4 Words VC1)	Data Structure
08 00 07 01 F2 I 00 00 00	Read Write / Index High / Index Low / Length / 1 byte data / 3 bytes unused

Write response (slave -> master)

Data (4 Words VC1)	Data Structure
88 00 02 05 F2 I 00 00 00	Read Write Response / Status / Length / Number of accessible devices / device status / 3 bytes unused

5.3.4 Specification of the Active Configuration via DP/V1

For DP/V1 you can access the activation status via Index 6. Index 7 is not supported here because it was optimized for the access via process data interface in particular.

Access via Index 6

Please observe the structure of Index 6 when accessing it:

Byte 1								Byte 2								Bytes 3 to 7	Byte 8							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	...	57	58	59	60	61	62	63	x

Bit = 0: Device and slot inactive

Bit = 1: Device and slot active

In this example there are 7 connected devices. The devices 1, 2, 3, 4, and 7 must be active. The devices 5 and 6 are inactive.

The resulting data for object 6 are the following:

F2_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}, 00_{hex}

These 8 data bytes are transmitted via DP/V1 in the following:



If a new activation status is described via Index 6, it becomes only valid as soon as the bus is restarted.

2 Corresponding Examples:

If - as described in this example - the configuration and the accessible devices are not identical, because e.g. 2 devices are not connected, the bus is read in continuously until it is identical with the configuration. In the course of this, the activation status on Index 6 is evaluated automatically.

If the dynamic bus structure is expanded and if previously inactive devices are attached to the end, these devices are activated via Index 6 at first. During the next bus start, the new devices are integrated into data traffic. The bus can be started via Index 4, bit 0. Please note that during reset the device output data are reset to their device-specific reset values.

Write request (master -> slave)

Data (8 Words VC1)	Data Structure
5F 00 06 08 F2 00 00 00 00 00 00 00	Write / Slot / Index / Length Data Total / Length / 8 bytes object data

Write response (slave -> master)

Data (8 Words VC1)	Data Structure
5F 00 06 08	Write / Slot / Index / Length

5.3.5 Summary

According to the respective task and the prerequisites in the control system, you can use the illustrated services (process data interface DP/V0 or DP/V1) to specify the actually operated configuration of the application. In this example the devices FLM DI 8 and FLM DO 8 have been deactivated via the illustrated services and thus must not be connected. For further information and examples regarding the communication via the process data interface as well as DP/V1, please refer to section "Acyclic Communication (DP/V1 and PCP)" on page 4-1.



The "PD-PCP x words" process data interface module does not have to be configured for normal operation. You only need it if you want to access the objects such as Index 6 via the process data.



If you want to use the "PD PCP x words" process data interface module (VC1), you can configure it at any position. However, we recommend to use the last position because here the configured slot and the actual slot will always be identical.

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A Appendix

A 1 Error Codes for PCP Communication

Table A-1 06_{hex}/02_{hex} (hardware fault)

Meaning	Access to the object failed due to a hardware fault.
Cause	For example, no I/O voltage.
Remedy	Remove the hardware fault.

Table A-2 06_{hex}/03_{hex} (object access denied)

Meaning	The object has limited access rights.
Cause	It may be a read-only object or it may be password-protected.
Remedy	Check the access rights in the object description.

Table A-3 06_{hex} / 05_{hex} (object attribute inconsistent)

Meaning	A service parameter has been specified with a value that is not permitted.
Cause	For example, an incorrect length specification or subindex that is not permitted.
Remedy	Check the parameters in the object description and send the service again with the corrected values.

Communication Error Messages

Table A-4 06_{hex} / 06_{hex} (object access unsupported)

Meaning	The service used cannot be applied to this object.
Cause	For example, a program sequence can be started or stopped, but not read.
Remedy	Check the object description to find out which services are supported for this object.

Table A-5 06_{hex} / 07_{hex} (object non-existent)

Meaning	The object does not exist.
Cause	The "index" parameter probably contains an invalid value.
Remedy	Check the object index in the object description and send the service again.

Other Error Messages

Table A-6 08_{hex} / 00_{hex} (application error)

Meaning	Device-specific error message; no communication error.
Cause	-
Remedy	Refer to your device description.



Depending on the I/O device, other specific error codes may also be used. These codes are listed in the relevant data sheet.

A 2 Error Codes for DP/V1 and VC1 Communication



Always observe the individual displays in your working environment.

DP/V1 error:

Function code (Response) = DE_{hex} (Error Read)

or function code (Response) = DF_{hex} (Error Write)

Error decode = 80_{hex} (DP/V1 communication)

Error with reference to I/O device:

Status 44_{hex} characterizes an error

- for DP/V1 on byte 3 of the data block,
- for VC1 Byte 2 in the response.

Table A-7 Error codes for DP/V1 and VC1 communication

Error_Code_1	Error_Code_2	Meaning
B0 _{hex}	0	Index invalid
B1 _{hex}	0	Invalid data length during writing
B2 _{hex}	0	Invalid device number
B5 _{hex}	0	Status conflict, last Read/Write not finished yet
B6 _{hex}	0	Access onto device or index not permitted
B7 _{hex}	0	Invalid parameters
C3 _{hex}	0	(Internal) resource not available
D1 _{hex}	0	PCP connection not established
D2 _{hex}	0	PCP is not supported
D4 _{hex}	0	Wrong service code
D5 _{hex}	0	Wrong sequence of fragments
D6 _{hex}	0	Wrong data length during access
D7 _{hex}	0	PCP PDU size of 64 bytes (58 bytes user data) per communication exceeded
DC _{hex}	0	(Internal) timeout while reading
DD _{hex}	0	(Internal) error when transmitting a request
DE _{hex}	0	(Internal) error when receiving a service

A 3 Format of the Parameter Telegram

This section provides a detailed description of the format of the parameters for the bus coupler and the input and output devices. This may be useful when setting parameters using acyclic services or if there is no interface for the simple selection of parameters.

Table A-8 Parameters for the bus coupler

Bytes 1 to 7	DP standard	
Bytes 8 to 10	DP/V1 standard	
Byte 11	Control byte	
	Bit 7	0: Hide channel-specific diagnostics 1: display channel-specific diagnostics
	Bit 6	0: Do not turn DI32 and DO32 data 1: Turn DI32 and DO32 data
	Bit 5	0: SET_PRM does not overwrite dynamic configuration 1: SET_PRM overwrites dynamic configuration
	Bit 4	0: Do not turn DI16 and DO16 data 1: Turn DI16 and DO16 data
	Bit 3	Reserved (set to 0)
	Bit 2	Reserved (set to 0)
	Bit 1	0: Automatically acknowledge I/O errors 1: Manually acknowledge I/O errors
	Bit 0	0: Stop local bus during device failure 1: Operating local bus with accessible devices



The data for the configuration and the data for the fail-safe value can be found in the device-specific data sheets.

Appendix

Table A-9 Parameters for the I/O devices byte 1

Byte 1	Bit 7 to bit 6	00: Start block ID for device
	Bit 5 to bit 4	Configuration
		00: No configuration (e.g., DO)
		01: Permanent configuration
		10: Temporary configuration
	Bit 3 to bit 2	Fail-safe value
		00: No fail-safe value (e.g., DI)
		01: Output zero
		10: Value remains the same
		11: Value from data field is used
	Bit 1	Extended functions
		0: No function block
		1: Function block (also several)
	Bit 0	Activation
		0: activated
		1: deactivated

Following one configuration block:

Byte x	Bit 7 to bit 6	01: Configuration block ID
	Bit 5 to bit 0	Length of the data block
Byte 3 to n		n data bytes

Following one fail-safe block:

Byte x	Bit 7 to bit 6	10: Fail-safe value block ID
	Bit 5 to bit 0	Length of the data block
Byte 3 to n		n data bytes

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If one or several function blocks are present, a header byte follows:

Byte x	Bit 7 to bit 6	11: Function block ID
	Bit 5 to bit 0	Entire function block length

After that the function blocks are decoded:

a) PCP Function Block

Byte x+1	Bit 7 to bit 6	01: PCP function block
	Bit 5 to bit 0	PCP function block length
Byte x+2		Invoke ID
Byte x+3		Index high byte
Byte x+4		Index low byte
Byte x+5		Subindex
Byte x+6 to x+6+n		n data bytes

b) Additional Function Block

Byte x+1	Bit 7 to bit 6	10: Additional function block
	Bit 5 to bit 0	Length of the additional function block
Byte x+2	Bit 0	1: I/O data rotate correctly 0: I/O data do not rotate correctly
	Bit 7 to bit 1	Reserved

c) ID Function Block (n <= 16)

Byte x+1	Bit 7 to bit 6	11: ID function block
	Bit 5 to bit 0	Length of the ID function block
Byte x+2	Bit 7 to bit 0	Order No. (last n sign), ASCII
Byte x+2+n	Bit 7 to bit 0	Order No. (last sign), ASCII

B Appendix: Ordering Data



The Phoenix Contact AUTOMATIONWORX catalog contains the ordering data for all Fieldline products.

This includes:

- Fieldline devices
- Bus cables
- Shielded bus connectors
- Unshielded connectors
- Other accessories



For additional information about Fieldline devices and accessories, visit the Phoenix Contact e-shop at www.phoenixcontact.com.



Complete documentation for the Fieldline devices can be found on the Internet at www.download.phoenixcontact.com.

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